NINGU of this is carried out.

[0190] As a broken line shows in drawing 158, after making it go up to 200-degreeC slowly over 10 minutes within clean oven and holding more than for 75 minutes in the condition conventionally, it had returned to ordinary temperature slowly over 10 minutes. On the other hand, in this example, it lays on the hot plate of 200-degreeC, and heats for 10 minutes. At this time, about 1 minute is taken for the temperature of a substrate to rise to 200-degreeC. Then, it cools radiationally for 10 minutes and returns to ordinary temperature. Thus, if sudden heating is carried out, as shown in (1) of drawing 157, the solvent in a resist will bump, and a bubble 362 will arise inside. In this bubble 362, as shown in (2) of drawing 157, the above is emitted outside from the front face of projection 20. The foaming marks 363 are formed in the front face of a projection at this time, and irregularity is produced.

[0191] In addition, if it stirs before applying the resist melted to the solvent, and air bubbles are introduced into a resist, it will become easy to foam by the time of carrying out sudden heating of the resist. Moreover, you may stir, introducing nitrogen gas, carbon dioxide gas, etc. While the air bubbles of gas are introduced into a resist by this, since it dissolves into a solvent, the fizz of gas [a part of] at the time of heating increases. Moreover, the clathrate compound which emits the water of crystallization which dehydrates about [120-200 degrees] by C, and a guest solvent to a resist may be mixed. Since water is emitted from water of crystallization, it becomes a steam or a guest solvent is emitted by this at the time of heating, it becomes easier to foam. Moreover, the silica gel which adsorbed a solvent or gas may be mixed into a resist. Since the solvent or gas to which it is sticking from silica gel is emitted by this at the time of heating, it becomes easier to foam. In addition, the solid ingredient to mix needs to be the magnitude below the height and width of face of a projection, and it is ground so that it may become such magnitude.

[0192] also making it such structure, although the detailed hole was established in the projection in the 37th example and the slot was established in the projection in the 38th example -- the front face of a projection -- the perpendicular orientation film -- forming -- ** -- it becomes. Drawing 159 is drawing showing the option which makes the projection which has a slot like the 38th example. As shown in (1) of drawing 159, the photoresist used for creation of a micro lens is used, it approaches and projections 365 and 366 are formed. This photoresist can change the configuration in which pattern NINGU was carried out by the exposure reinforcement of light, baking (BEKU) temperature, presentation, etc., a projection collapses and by setting up suitable baking conditions comes to show it to (2). If the perpendicular orientation film 22 is applied to this, since the center section of the projection 20 has become depressed as shown in (3), the perpendicular orientation film 22 will be formed good. After applying the above-mentioned ingredient to the thickness of 1.5 micrometers, pattern NINGU of the projections 365 and 266 was carried out so that it might become width of face of 3 micrometers, and spacing of 1 micrometer of a projection. And BEKU [180 degreeC] from 10 minutes for 30 minutes. Thereby, two projections united and it became as shown in (2) of drawing 159. The desired configuration was acquired by controlling the time amount of BEKU. If the height of a projection is set to 5 micrometers or more, projections 365 and 266 influence cel thickness (thickness of a liquid crystal layer), and although it seems that two projections will unite if 0.5 micrometers to 5 micrometers and width of face is [height] 2 micrometers to 10 micrometers and the range of spacing is 0.5 to 5 micrometers, when pouring in liquid crystal, they will become hindrance. Moreover, if width of face of a projection is set to 2 micrometers or less, the orientation restraining force of a projection will decline. Furthermore, if it is difficult to unite two projections if spacing of a projection is set to 5 micrometers or more and it makes it 0.5 micrometers or less, a hollow will not be made in the center.

[0193] As mentioned above, although the wettability improvement processing to the ingredient of the orientation film of the projection in the 39th example was explained, what kind of pattern is sufficient as a projection, and a cross-section configuration does not need to be a boiled-fish-paste mold, either. Furthermore, the ingredient which forms a projection just also forms a projection not only in a photoresist but in a desired configuration. However, if it takes into consideration forming irregularity chemically or physically in a next process, the thing in which ashing is possible is [that it is hard to separate softly as the quality of the material] suitable. As an ingredient which suits this condition, resin ingredients, such as a photoresist, black matrix resin, color filter resin, overcoat resin, and polyimide, are suitable. Moreover, with such an organic material, surface reforming (processing) is possible by ashing, UV irradiation, etc.

[0194] As explained above, since the wettability to the ingredient of the orientation film on the front face of a projection is improved, while failure that the orientation film is not formed in a projection front face can be

prevented and display quality improves, the yield improves in the 39th example. In order to prevent conventionally the fall of the contrast by the leakage light which passes the part between each pixel, preparing the so-called black matrix in the periphery of each pixel is performed. Drawing 160 is drawing showing the panel structure of the conventional example where the black matrix was established. Like illustration, on the color filter (CF) substrate 16, R (red) filter 39R, G (Green) filter 39G, and B (blue) filter 39B are formed corresponding to a RGB pixel, and the ITO electrode 12 is formed on it. Furthermore, the black matrix 34 is formed in the boundary part of each RGB pixel. A data bus line, a gate bus line, or the TFT component 33 is formed in the TFT substrate 17 with the ITO electrode 13. The liquid crystal layer 3 is formed between two substrates 16 and 17.

[0195] Drawing 161 is drawing showing the panel structure of the 40th example of this invention, and drawing 162 is drawing showing the projection pattern in the pixel of the 40th example. Like illustration, R filter 39R, G filter 39G, and B filter 39B are formed on the CF substrate 16. Although not illustrated in drawing 161, as shown in drawing 162, projection 20A for orientation control prepared with the liquid crystal panel of the 1st example is formed in the CF substrate 16. This projection 20A is made from the ingredient of protection-from-light nature. The projection 61 is formed in the periphery of each pixel, this projection 61 is also made from the protection-from-light nature ingredient, and it functions as a black matrix. Therefore, it is not necessary to form the black matrix 34 like the conventional example. The projection 61 which functions as this black matrix can be formed in projection 20A and coincidence, and if such a manufacture approach is used, it can skip the black matrix creation process of the creation time of the CF substrate 16. In addition, a reference number 62 is the part of TFT of each pixel, and projection 61 is formed so that this part may also shade.

[0196] In addition, in drawing 161, although projections 20A and 61 are formed in CF substrate side 16, both projection 61 or the projections 20A and 61 may be formed in the TFT substrate 17 side. Thereby, it becomes unnecessary to take into consideration gap of the lamination of CF substrate side 16 and the TFT substrate 17, and the numerical aperture of a panel and the yield of a lamination process can be raised by leaps and bounds. the part which shifted when a black matrix was prepared in the CF substrate 16 side, the ITO electrode 13 of the TFT substrate 17 and opening (part without a black matrix) of the CF substrate 16 were similarly completely designed and lamination gap occurred in a panel production process -- optical leakage -- a lifting -- a normal display is not obtained. Usually, no matter highly precise equipment [what / lamination] it may use, about **5 micrometers of doubling errors exist. Therefore, in consideration of the margin of the part, he designs opening of a black matrix more smallish, and is trying for such a problem not to arise. That is, he is trying for a black matrix to cover about 5-10 micrometers to the inside from the ITO electrode 13 by the side of the TFT substrate 17. If projection 61 is formed in the TFT substrate 17 side, since it is not influenced by lamination gap, a numerical aperture can be made high to the maximum extent. This effectiveness becomes larger as the pixel of a panel becomes small (i.e., so that resolution goes up). For example, in order to take an every 5 micrometers margin if it is the conventional method although the substrate whose dimensions of the ITO electrode of a pixel are 80 micrometers wide and 240 micrometers long was used in this example, it becomes 70 micrometers wide and 230 micrometers long opening, and the opening area of a pixel is 2 16100 micrometers. It becomes. on the other hand -- this example -- the opening area of a pixel -- 19200micrometer2 it is -- a numerical aperture is improved about 1.2 times of the conventional method. If a display twice the resolution of this panel, then the dimension of an electrode are 40 micrometers wide and 120 micrometers long and it is the conventional method, the opening area of a pixel is 2 3300 micrometers. If it becomes and is this example, the opening area of a pixel is 2 4800 micrometers. It becomes and will be improved about 1.5 times. Thus, it is more effective as resolution goes up.

[0197] Drawing 163 is drawing showing the pattern of the black matrix (BM) of the 41st example. As mentioned above, leakage light arises in the part of a domain regulation means. As mentioned above, although using the very small domain where 90-degree azimuths which exist near the summit of a projection differ is also considered, when stable orientation is not obtained near the summit of a projection, leakage light arises. Therefore, in order to improve contrast etc., it is desirable to shade the part of a domain regulation means. Although it is possible to form a projection with a protection-from-light ingredient in order to shade the part of a projection, the 41st example shades the part of a domain regulation means by the black matrix (BM).

[0198] As mentioned above, although BM34 is used in order to shade the leakage light of the boundary part of TFT and a cel electrode, and a bus line, in the 41st example, this BM is prepared also in the part of a domain regulation means. Thereby, the leakage light in the part of a domain regulation means can be shaded, and

contrast improves. Drawing 164 is a sectional view of the panel of the 41st example. Like illustration, BM34 is formed corresponding to the clearance between Projections 20A and 20B, TFT33, and a bus line (here, only the gate bus line 31 is shown.) and the cel electrode 13.

[0199] Drawing 165 is the pixel pattern of the 42nd example. The delta array which makes a display pixel a square mostly, and the array pitch of a display pixel shifts 1/2, and arranges the display pixel of the adjoining train from the former is known. In the case of a color liquid crystal display, 1 set of color pixel groups are formed by three pixels 13B, 13G, and 13R which adjoin mutually. Since each pixel is a form near a square, even if it does not make the gap of a projection not much small compared with the case of the rectangle of 1 to 3, it becomes easy to make equal the rate of the liquid crystal molecule by which orientation division is carried out at least in all directions. In this case, it is made for a data bus line to extend in zigzag along the periphery of a pixel. Thus, a delta array is very effective, when forming the train of the projection which continued all over the substrate, or a hollow and carrying out orientation division.

[0200] The 43rd example explained below is an example which uses as a spacer the projection 61 which functions as the projection for orientation control, or a black matrix of the 40th example. A spacer is used in order to make distance between two substrates (cel thickness) into a predetermined value, as shown also in drawing 18. Drawing 166 is drawing showing the panel structure in the conventional example, and a spacer 45 is arranged at the boundary part of a pixel, and it specifies cel thickness. A spacer 45 is a ball which has a predetermined diameter.

[0201] Drawing 167 is drawing showing the panel structure of the 43rd example, and, as for (2), (1) shows the modification for the panel structure of the 43rd example. As shown in (1) of drawing 167, by the panel of the 43rd example, the projection 64 prepared in the periphery of a pixel is thickened to cel thickness, and projection 64 prescribes cel thickness. In addition, in this drawing, although the projection 64 is formed in the TFT substrate 17 side, it may be formed in the CF substrate 16 side. It becomes unnecessary thus, to form a spacer by constituting. In addition, since liquid crystal does not exist in the part of this projection 64, case [like a perpendicular orientation mold], a projection part (a part for a cel attaching part) always serves as a black display regardless of applied voltage. Therefore, a black matrix is unnecessary, it is not necessary to form projection 64 with the ingredient which has protection-from-light nature, and it may be made from a transparent ingredient.

[0202] In the 43rd example shown in (1) of drawing 167, although the projection 64 had prescribed cel thickness, the precision of cel thickness is influenced in the formation precision of a projection, and precision falls compared with the case where a spacer is used. The variation in cel thickness is controllable within **0.1 micrometers, as a result of actually manufacturing a panel in the form of the 16th example, if it is this level, especially in the present condition, it will not become a problem, but it is not suitable when strict cel thickness needs to be controlled. The modification shown in (2) of drawing 167 is the structure for solving such a problem. In the modification of (2) of drawing 167, into the resin which forms projection 65, a spacer 45 is mixed and applied, patterning of it is carried out, and a projection is formed. Although the advantage of the 43rd example that a spacer is unnecessary is lost in this modification, there is an advantage that cel thickness can be specified without being influenced by the formation precision of a projection pattern. Cel thickness was able to be made into the precision of **0.05 micrometers as a result of actually manufacturing a panel in the form of (2) of drawing 167. Moreover, although it is unchanging for needing a spacer, in order to make a spacer mix in resin and to arrange a spacer on a cel to the resin and coincidence of a projection, it is not necessary to sprinkle a spacer to a panel chemically-modified degree anew, and a process does not increase.

[0203] Drawing 168 is also drawing showing the modification of the 43rd example, (1) is what considered the projection 64 in the 43rd example of (1) of drawing 167 as the projection 66 which made from the ingredient of protection-from-light nature, and (2) considers the projection 65 of drawing 167 of (2) as the projection 67 made from the ingredient of protection-from-light nature. As mentioned above, in (1) of drawing 167, and (2), although these projections fully achieve the function of a black matrix even if it forms projection 64 or 65 by the transparent material, protection-from-light nature with more perfect forming this with a protection-from-light ingredient is obtained.

[0204] It is drawing showing the modification of the 43rd example, and the projection 68 was formed in the CF substrate 16, and drawing 169 also formed the projection 69 in the TFT substrate 17, respectively, and has specified cel thickness by contacting them. About effectiveness, it is the same as the 43rd example and its modification. Although the projection prepared in the periphery of a pixel has prescribed cel thickness in the

43rd example and its modification, it is also possible to specify cel thickness by the projection for orientation control, for example, projection 20of drawing 162 A.

[0205] Furthermore, although the projection was formed over all the peripheries of a pixel in the modification of the 40th example, the 43rd example, and the 43rd example, it is also possible to form a projection in a part of periphery of a pixel. For example, the projections 61, 64-69 of the 41st example and the 41st example were formed in the TFT part of each pixel, i.e., the part shown with the reference number 62 of drawing 162, with the ingredient of protection-from-light nature. As mentioned above, VA (Vertically Aligned) By the so-called panel in the normally black mode which displays black when the electrical potential difference has not joined an ITO electrode like a method, even if it omits a black matrix, leakage light hardly becomes a problem. Therefore, only the part of TFT is covered by the resin of protection-from-light nature, and it was made not to prepare on the drain bus of a pixel periphery, and a gate bus like this example. Moreover, as above-mentioned, if the protection-from-light section decreases, a numerical aperture improves so much and it is advantageous. The configuration which forms a projection only in a TFT part is applicable also to the 41st example shown in drawing 169 from drawing 167, and its modification.

[0206] In the 43rd example, although the function of a spacer was given to the black matrix, in giving the function of a spacer to neither a black matrix nor a projection, after while having formed the perpendicular orientation film and sprinkling as usual the spherical spacer which has a diameter equal to a substrate to cel thickness, the substrate of another side will be stuck. However, when a projection is formed on an electrode, some sprinkled spacers will be located on a projection. If the diameter of a spacer is made equal to cel thickness in case there is no projection, cel thickness will become larger than a desired value for the spacer which gets on a projection. Furthermore, the force joins the once assembled panel from the exterior, in [a spacer projecting], cel thickness becomes [the part] large with ******, and problems, such as display unevenness, arise. It is made for such a problem not to arise by reducing the diameter of a spacer beforehand in consideration of the thickness of a projection in the 44th example explained below.

[0207] Drawing 170 is drawing showing the panel structure of the 44th example, and shows the condition that (1) assembled, (2) assembled the front TFT substrate 17, and (3) assembled the front CF substrate 16. Projection 20A is formed on the electrode 12 of the CF substrate 16, the perpendicular orientation film 22 is formed further, projection 20B is formed on the electrode 13 of the TFT substrate 17, and the perpendicular orientation film 22 is further formed as shown in (1) of drawing 170, and (2). Projections 20A and 20B are 1 micrometer in the same height, and when it sees from a panel side, they are assembled so that it may not cross mutually. Cel thickness is 4 micrometers and the diameter of the spacer 85 made from plastics is 3 micrometers which subtracted the height of a projection from cel thickness. it is shown in (1) of drawing 170 -- as -- the TFT substrate 17 -- a spacer 85 -- 150-300 piece/mm2 It sprinkles. a seal is formed in the CF substrate 16 with the resin made from adhesion, and it sticks [it is alike and] on the TFT substrate 17. As shown in (3), a spacer 85 is located on projection 20B or under 20A by a certain probability. This probability is the whole area of the part of Projections 20A and 20B rate of. If it is in the condition of (3), cel thickness will be regulated by the thickness of the spacer located on projection 20B or under 20A, and a projection. The spacer 45 in parts other than projection 20A and 20B turns into a suspension spacer which does not influence cel thickness. Since cel thickness is regulated by Projections 20A and 20B, cel thickness hardly becomes larger than a desired value. Moreover, even if spacers other than the part of a projection during use of a panel move to the part of a projection, cel thickness does not become thick, and even if the spacer which suited the projection part moves to parts other than a projection, it only becomes a suspension spacer.

[0208] Drawing 171 is drawing showing the spraying consistency of a spacer, and the relation of cel thickness. It is the spraying consistency of a spacer 100-500 pieces/mm 2 Then, cel thickness serves as the range of 4micrometer**0.5micrometer. Next, the unevenness of cel thickness and the experimental result of the spraying consistency of a spacer which are generated when the force is applied to a panel from the exterior are shown in drawing 173. This result to a spraying consistency is 2 150 pieces/mm. Below, it is easy to generate unevenness to force application, and is 2 300 pieces/mm. Above, it is easy to generate unevenness to hauling. Therefore, a spraying consistency is 2 150-300 pieces/mm. It is the optimal.

[0209] By the production process of a liquid crystal display panel, an ionicity impurity may be incorporated or the ion eluted from the ion and orientation film which are contained in liquid crystal, a projection formation ingredient, a sealant, etc. may mix into a liquid crystal panel. If ion mixes into a liquid crystal panel, in order for the specific resistance of a panel to fall, the effectual electrical potential difference impressed to a panel will

fall, and it will become the cause which display unevenness generates. Moreover, mixing of ion also becomes the cause of generating printing of a display on a panel, and leads also to decline in electrical-potential-difference retention further. Thus, when ion mixes in a panel, the display quality and dependability of a liquid crystal panel will fall.
[0210] Therefore, it is desirable to prepare the ion adsorption capacity force in the projection of the dielectric formed on the electrode used as a domain regulation means explained in the old example. In order to give the ion adsorption capacity force, there are two approaches. One is irradiating ultraviolet rays and another side is adding the ingredient which has the ion adsorption capacity force into the ingredient of a projection. If ultraviolet rays are irradiated, since the surface energy of a projection formation ingredient will go up, the ion adsorption capacity force is heightened. Surface energy gamma is expressed with the sum of polar term gammap of surface energy, and distributed term gammad of surface energy. A polar term is based on coulomb electrostatic force, and a distributed term is based on the dispersion force of the Van der Waals force. If ultraviolet rays are irradiated, cutting of association of the low part of binding energy will break out, and the cut part and the oxygen in air will join together. By that cause, surface polarizability increases, a polar term becomes large, and surface energy increases. If the degree of polarization increases, ion will become that a front face is easy to adsorb. That is, a projection front face comes to have the ion adsorption capacity force by irradiating ultraviolet rays. In case ultraviolet rays are irradiated, it is desirable to irradiate only a projection alternatively, but since association of a projection formation ingredient tends to go out rather than association on the front face of a substrate, even if it irradiates ultraviolet rays all over a panel, only a projection comes to have the ion adsorption capacity force. After irradiating ultraviolet rays, the perpendicular orientation film is formed.
[0211] As an ingredient which has the ion adsorption capacity force, ion exchange resin, a chelating agent, a silane coupling agent, silica gel, the alumina, the zeolite, etc. are known. Among these, ion exchange resin exchanges ion, and although it supplements with the ion which existed from the beginning as an impurity instead, it is not suitable [ion exchange resin] for adding into a projection formation ingredient in order to emit another ion. Since the ingredient which has the capacity supplementary to ion exists in the ingredient which has the chelate organization potency force, without emitting another ion, it is desirable to use such an ingredient. As such an ingredient, there are crown ether as shows a chemical formula in drawing 173, and cryptand as show a chemical formula in drawing 174. Furthermore, it has the capacity supplementary to ion, without inorganic materials, such as an alumina and a zeolite, also emitting ion. Therefore, these ingredients are used. In addition, since a limitation is in the class of ion adsorbed only with one ion adsorption ingredient, it is good to use it combining the ingredient which adsorbs different ion.
[0212] The result of having formed the projection train whose height the gap between 1.5micro and a projection is width of face of 7.5 micrometers, and is 15 micrometers by the positive resist, having performed processing which gives various kinds of above-mentioned ion adsorption capacity force, and having measured early ion density and the ion density (unit pc) after using it for 200 hours by the manufactured panel is shown in drawing 253. In drawing 253, the ultraviolet rays of 1500mJ(s) were irradiated in Example C, 0.5 percentage by weight of crown ether was added in Example D, the zeolite was added in Example E, and crown ether and a zeolite were added in Example F. In addition, the case where processing which gives the ion adsorption capacity force for reference is not performed is shown as an example of a comparison. Impressing the 0.1Hz triangular wave of 10V at the time of use, the temperature at the time of measurement is 50-degreeC. The initial value of ion density is the almost same level irrespective of the existence of this result to ion adsorption capacity force processing. However, the ion density of 200 hours after is increasing sharply, when not processing, but if it processes, it is understood that there are few increments.
[0213] Moreover, although printing occurred when the running trial of what irradiated ultraviolet rays, and the thing which does not process at all was actually carried out for 500 hours, and not processing, printing was not generated in what irradiated ultraviolet rays. Although the configuration which forms the near projection pattern of the CF substrate 16 by the black matrix is indicated in the 40th example, it explains in more detail about this.
[0214] As mentioned above, if a projection pattern can be formed in the CF substrate 16 using the conventional process, since a new process will not be added, the increment in cost for formation of a projection pattern can be suppressed to the minimum. The 45th example is an example which forms a projection pattern in the CF substrate 16 using the conventional process. Drawing 175 is drawing showing the structure of CF substrate of the 45th example. As shown in (1) of drawing 175, in the 45th example, color filter resin (CF resin) 39R and

39G (otherwise, it is 39B) is formed for every pixel on the CF substrate 16. And on it, with suitable ingredients, such as a black matrix, CF resin, and other flattening resin, projection turn 50A is formed at a position, and ITO (transparent electrode) 12 is formed on it. Although especially the ingredient of a black matrix is not limited, in order to form a projection, a certain amount of thickness is required, and it is desirable to use resin, when it is taken into consideration.

[0215] (2) of drawing 175 is drawing showing the modification of CF substrate of the 45th example, on the CF substrate 16, is suitable ingredients, such as a black matrix, CF resin, and other flattening resin, and forms projection turn 50B at a position. Then, if CF resin 39R and 39G is formed, since CF resin laps, the part of a projection will become thick and will be projecting as it is. ITO(transparent electrode) 12 is formed in this.

[0216] A projection can be formed in any location of CF substrate if it is the structure of the 45th example. Drawing 176 is drawing showing the panel structure of the 46th example. In the 46th example, projection 50 is formed in the part of the joint of the black matrix, Periphery 39R, 39G, and 39B, i.e., CF resin, of a pixel of the CF substrate 16, 34, and projection 20B is formed in the TFT substrate 17 in the middle of this joint. Therefore, in forming the projection which continued on the side of the lot which the joint of each pixel counters with the CF substrate 16, i.e., a straight-line-like projection pattern, it forms the straight-line-like projection pattern which is parallel to this projection pattern near the core of the pixel of a TFT substrate. Moreover, since it becomes a pattern as shown in drawing 80 and drawing 81 when forming the projection which continued on all the sides of the joint of each pixel with the CF substrate 16, a square drill-like projection is formed near the core of a pixel at the TFT substrate 17.

[0217] If it is the panel structure of the 46th example, various modes are possible for the structure. Hereafter, the example of the structure of CF substrate of the 46th example is explained. Drawing 177 to the drawing 182 is drawing showing the example of structure of CF substrate of the 46th example. In (1) of drawing 177, the black matrix (BM) 34 is established between CF resin 39R and 39G, BM34 is formed more thickly than CF resin, and the ITO electrode 12 is formed on it. The part of BM34 is projecting. It is desirable to form BM34 by resin etc. also in this case.

[0218] In (2) of drawing 177, after forming thin BM34 with a metal etc. on the CF substrate 12 and forming a color filter by CF resin 39R and 39G on it, projection 70 is further formed by CF resin 39R, and the ITO electrode 12 is formed further. In (1) of drawing 178, after forming thin BM34 with a metal etc. on the CF substrate 12 and forming a color filter by CF resin 39R and 39G on it, projection 71 is formed with resin other than BM34 and CF resin, for example, the resin used for flattening material, and the ITO electrode 12 is formed further. In this case, flattening material is formed like (1) of drawing 177 more thickly than CF resin.

[0219] In (2) of drawing 178, after forming BM34 for thickness of a projection by resin etc. on the CF substrate 12, and forming a color filter by CF resin 39R and 39G so that it may lap with BM34, the ITO electrode 12 is formed further. The part of CF resin which laps with BM34 is projecting. In (1) of drawing 179, after forming thin BM34 with a metal etc. on the CF substrate 12 and forming CF resin 39R on it, CF resin 39G are formed so that it may lap with CF resin 39R, and the ITO electrode 12 is formed further. The part with which CF resin laps is projecting. Since there is BM34 in the part of a projection and light is not passed, which color filter resin may be a top. If it is this structure, since a projection can be formed at the process which forms a color filter, a process does not increase.

[0220] By (1) of drawing 177, it forms (2) of drawing 179 so that a part of CF resin 39R and 39G may lap with the flattening material 71. The part to which CF resin laps with the flattening material 71 is projecting. Thereby, the flattening material 71 can be made thin to a part for the height of a projection. The above structure forms an ITO electrode after a projection, and although it is structure which has a projection in an electrode, it explains the example which forms a projection by the insulating material on an ITO electrode next.

[0221] In drawing 180, after forming a color filter in the CF substrate 16 by CF resin 39R and 39G, the ITO electrode 12 is formed further and a projection is formed by BM34 on it. A process does not increase in this case, either. In (1) of drawing 181, after forming thin BM34 in the CF substrate 16, the ITO electrode 12 is formed and a color filter is formed by CF resin 39R and 39G on it. CF resin 39R and 39G is considered as a projection in piles in that case. A process does not increase in this case, either.

[0222] In (2) of drawing 181, after forming thin BM34 in the CF substrate 16, a color filter is formed by CF resin 39R and 39G, the ITO electrode 12 is formed further, and projection 50E is formed by flattening material on it. In (1) of drawing 182, after forming the ITO electrode 12 in the CF substrate 16, a color filter is formed by CF resin 39R and 39G on it, and a projection is formed by BM34.

[0223] In (2) of drawing 182, after forming thin BM34 in the CF substrate 16, a color filter is formed by CF resin 39R and 39G on it, and flattening material 50F front face is made flat. The ITO electrode 12 is formed on it, BM34 is formed further, and it considers as a projection. Drawing 183 and drawing 184 are drawings explaining the production process of the color filter (CF) substrate in the 47th example. This CF substrate has a projection as a domain regulation means.
[0224] As shown in (1) of drawing 183, a glass substrate 16 is prepared. Next, as shown in (2), 1.3 micrometers resin (B resin: CBmade from the Fuji hunt- 7001) 39B' for filters of CF of a negative mold for blue is applied on a glass substrate 16. As shown in (3), an B resin is formed in the parts of a blue (B) picture element part, the BM section, and projection 20A by the photolithography method which used a photo mask 370 like illustration. Next, as shown in (4), resin (R resin: CRmade from the Fuji hunt- 7001) 39R' for filters for red is applied, and R resin is formed in the parts of a red (R) picture element part, the BM section, and projection 20A by the photolithography method which used the photo mask 371. Furthermore, as shown in (5), resin (G resin: CGmade from the Fuji hunt- 7001) 39G' for filters for Green is applied, and G resin is formed in the parts of the Green (G) picture element part, the BM section, and projection 20A by the photolithography method which used the photo mask 372. According to the above process, only one layer of three layers of resin of B, G, and R laps with BM section and projection 20A, and the color filter (CF) resin corresponding to each picture element part of B, G, and R is formed. The part with which three layers of resin of B, G, and R lapped turns into a part for Kurobe which hardly penetrates light. Next, about 1.5 micrometers (Hitachi Chemical make: H.P.-1009) of transparence flattening resin are applied by the spin coater, and after carrying out post baking in the oven of 230-degreeC for 1 hour, the ITO film is formed by the mask spatter. Next, they are the ultraviolet rays which prebake a black positive resist (Tokyo adaptation make : CFPR-BKP) after about 1.0 - 1.5-micrometer spreading by the spin coater, let CF resin pass from the tooth back of a glass substrate 16, and contain the wavelength of 365nm as shown in (6) 1000 mJ/cm2 It exposes. Since the permeability of ultraviolet rays is low compared with other parts, the part with which three layers of resin of B, G, and R lapped does not reach the threshold of exposure. And if negatives are developed with an alkali developer, since the BM section 34 and projection 20A which were not exposed will be formed, post baking is carried out in the oven of 230-degreeC for 1 hour. Furthermore, the perpendicular orientation film 22 is formed and CF substrate is completed.
[0225] Drawing 185 is a sectional view of the liquid crystal panel which stuck the CF substrate 16 and the TFT substrate 17 which were manufactured as mentioned above, and was completed. The slit 21 is formed in the TFT substrate 17 as a domain regulation means at the pixel electrode 13, and the perpendicular orientation film 22 is formed on it. Reference numbers 40 are a gate protective coat and a channel protective coat. In addition, BM34 and the resin, B, G, and R, of three layers have lapped with the part to be shaded, and protection-from-light nature is good. Moreover, projection 20A of the CF substrate 16 and the slit 21 of the TFT substrate 17 divide the orientation of liquid crystal, and a good viewing-angle property and a high working speed are obtained.
[0226] In the 47th example, as explained above, since it is not necessary to perform pattern exposure and pattern NINGU can be carried out by tooth-back exposure when forming projection 20A which is the domain regulation means of CF substrate, and BM34, projection 20A and the formation process of BM34 become easy, cost is reduced, and the yield improves. In addition, in the 47th example, although the pigment-content powder method is used for formation of CF, when forming a staining technique and the nonphotosensitivity resist which is making polyimide etc. distribute a pigment by etching, it can apply similarly. Moreover, although three layers of CF resin were put on projection 20A and the part of BM34 in the 47th example, two-layer is possible if the wavelength and exposure energy of exposure light at the time of tooth-back exposure are chosen suitably.
[0227] Although the projection which is a domain regulation means was formed in CF substrate without pattern NINGU with BM in the 47th example, also when forming only BM, without forming a projection, naturally it can apply. A projection is an example which forms BM, without forming by the approach as the 47th example that the 48th example is the same. Drawing 186 is drawing explaining the production process of CF substrate in the 48th example, and drawing 187 is drawing showing the panel structure of the 48th example.
[0228] The 48th example forms the BM projection 381 only in the part corresponding to BM for CF resin in piles, without putting CF resin on the part corresponding to a projection. Next, without carrying out, as shown in (1) of drawing 186, flattening forms the ITO film 12 and applies about 2.0 micrometers - the 2.5 micrometers of the above-mentioned black positives resist 380 in predetermined thickness, for example. By carrying out tooth-back exposure on it, and developing negatives, the panel which piled up the BM resist 380 after the BM

projection 381 as shown in (2) of drawing 186 is obtained. BM is made by both the BM projection 381 and the BM resist 380.

[0229] A panel as stuck such a CF substrate and a TFT substrate and shown in (1) of drawing 187 is manufactured. (2) of drawing 187 is the enlarged drawing of the circular parts of the dotted line of (1), and the BM resist 380 touches the TFT substrate 17, and it has specified the distance between substrates by both the BM projection 381 and the BM resist 380. That is, the BM projection 381 and the BM resist 380 have played the role of a spacer.

[0230] As explained above, in order for BM to play the role of a spacer, in the 48th example, it is not necessary to form a spacer, when it is not necessary to carry out pattern NINGU of the BM and a process becomes easy. In addition, although BM was formed in the 48th example, without carrying out pattern NINGU by tooth-back exposure using a positive resist, as long as it carries out pattern NINGU by the photolithography method, the resist of both a negative mold and a positive type may be used. Moreover, since the projection which is a domain regulation means, and work of a spacer are naturally carried out even if not black, it is effective also in the 47th example.

[0231] Next, the example which uses as BM the projection 381 which piled up CF resin in the 48th example as it is is explained. Drawing 188 is drawing explaining the production process of CF substrate in the 48th example, and drawing 189 is drawing showing the panel structure of the 48th example. As shown in (1) of drawing 188, the projection 381 which hardly penetrates three layers of light for CF resin in piles into the part of BM is formed. Next, as shown in (2), after applying about 1.5 micrometers of the above-mentioned transparence flattening resin by the spin coater and carrying out postbake by 230-degreeC for 1 hour, the ITO film 12 is formed. Furthermore, as shown in (3), about 1.0-1.5 micrometers (SHIPUREI Far East company make: SC-1811) of positives resist are applied, and projection 20A is formed by the photolithography method after prebaking. Since the projection 381 which piled up three layers of CF resin of B, G, and R hardly penetrates light, it acts as BM. Thus, by sticking the completed CF substrate 16 through the TFT substrate 16 and a spacer 45, a panel as shown in drawing 189 is completed.

[0232] Although the 49th example explained the example which forms BM for CF resin in piles from the 47th example, the liquid crystal display of VA method which pinches negative-mold liquid crystal is a normally black, and the non-picture element part to which an electrical potential difference is not impressed hardly penetrates light. Therefore, in the case of a normally white, BM which shades a non-picture element part can also use the thing of light transmittance which becomes a problem. That is, it can be said that BM should just be to some extent low light transmittance. The 50th example is an example which simplifies manufacture of CF substrate paying attention to such a point, and uses an B resin for one CF resin and a concrete target as BM. This does not produce a problem as display quality, either.

[0233] Drawing 190 is drawing explaining the production process of CF substrate in the 50th example, and drawing 191 is drawing showing the panel structure of the 50th example. As shown in drawing 190, they are R and G (the Fuji hunt company make: CR-7001, CG-7001) on a glass substrate 16. Negative-mold B photopolymer after forming CF resin of two colors (the Fuji hunt company make: CB-7001) It applies by the spin coater or the roll coater, and prebakes. Then, they are the ultraviolet rays which contain the wavelength of 365nm from the tooth back of a glass substrate 16 300 mJ/cm2 It exposes, negatives are developed with an alkali developer (the Fuji hunt company make: CD), and postbake is carried out in the oven of 230-degreeC for 1 hour. Then, the ITO film is formed and the perpendicular orientation film is formed further. That is, an B resin will be formed in addition to the part in which CF resin of R and G is formed. Therefore, an B resin will be formed in a part with the need of shading if it is made not to form CF resin of R and G in a part with the need of forming BM and shading.

[0234] As shown in (1) of drawing 191, B resin 39B is formed in the part of the bus lines 31 and 32 with the need of shading, and the part of TFT, as BM. In addition, (2) of drawing 191 is drawing which expanded the circular parts of the dotted line of (1), and when sticking two substrates for the width of face of the CF side protection-from-light section (B resin) 382 shown by the arrow head on the width of face of the bus lines 31 and 32 of the TFT substrate 17 like illustration, it can also obtain a high numerical aperture by making it the width of face which added margin **.

[0235] In the 50th example, generally, since the permeability of g of sensitization wavelength, h, and i line was B resin >R resin >G resin, it formed the B resin at the end, but if CF resin with high (there is little light exposure and it is good) exposure sensibility and CF resin with high sensitization wavelength permeability are

formed at the end, the resin remainder of the last formation color is hard to generate and is effective on the already formed resin. Furthermore, it is also effective to form an alignment mark in the Isshiki eye with a pixel pattern using the color (generally [in the transmitted light] B>R>G) resin which the location alignment mark of an aligner tends to identify.

[0236] Drawing 192 is drawing showing the structure of CF substrate of the 51st example. In the conventional liquid crystal display, BM34 of a metal membrane was formed on the glass substrate 16, CF resin was formed on it, and the ITO film was further formed on it. On the other hand, in the 51st example, BM is formed on the ITO film. In the 51st example, like the example explained until now, pattern NINGU of the CF resin 39 is carried out, and it is formed on a glass substrate 16. Transparence flattening material may be applied if needed. Next, the transparent ITO film 12 is formed and a light-shielding film 383 is formed in the part of illustration on it. For example, the spatter of about 0.1 micrometers of the ITO film 12 is carried out through a mask, and about 0.1 micrometers of Cr(s) are formed as a light-shielding film layer on it. Furthermore, on a light-shielding film layer, a resist is applied to homogeneity by the methods of application, such as a spin coat method, about 1.5 micrometers in thickness, exposure of the pattern of a light-shielding film, development, etching, and exfoliation are performed, and a light-shielding film 383 is formed. A light-shielding film 383 is conductivity in Cr, and since a touch area with the ITO film 12 is also large, it is effective in making low resistance of the ITO film 12 in the whole substrate. In addition, formation of the ITO film 12 or a light-shielding film 383 may be performed by what kind of approach. For example, if it is the conventional approach, after membrane formation of the ITO film 12, it will anneal, substrate washing will be performed, Cr film will be formed, but in the 51st example, since it becomes possible to perform membrane formation of the ITO film 12 and Cr film continuously within 1 equipment and it can reduce washing processes, a process can be simplified. Therefore, membrane formation equipments can be reduced and equipment can also be made small.

[0237] Drawing 193 is drawing showing the modification of CF substrate of the 51st example. In (1) of drawing 193, after forming three CF resin and forming another resin 384 in the slot of the boundary section of CF resin, the ITO film 12 and a light-shielding film 383 are formed. In (2) of drawing 193, like the 50th example explained in drawing 190, after forming two CF resin 39R and 39G, about 1.5 micrometers of B resins were applied, tooth-back exposure was carried out, negatives were developed, and the flat front face was formed. The ITO film 12 and a light-shielding film 383 are formed on it. If it is this, since the front face of CF layer is flat, an open circuit of the ITO film will be lost and resistance of the ITO film 12 in the whole substrate can be further made low.

[0238] In addition, if the low coloring resin of a reflection factor is used as the resin 384 under a light-shielding film 383, or 39B, it is possible for the reflection factor of the protection-from-light section to become low, and to carry out reflection of the outdoor daylight of a liquid crystal display to low reflection more. Furthermore, if the low coloring resin of permeability is used as the resin 384 under a light-shielding film 383, or 39B, it is possible for the permeability of the protection-from-light section to become low, and to form a liquid crystal display into high contrast.

[0239] Moreover, since it is not necessary to carry out pattern NINGU when forming CF resin 34B if it is the structure of (2) of drawing 193, it becomes unnecessary to use the aligner in which that much expensive pattern NINGU is possible, plant-and-equipment investment can be lessened, and cost can also be reduced. Drawing 194 is drawing showing the modification of the 51st example, and a spacer 45 is formed on the light-shielding film formed in the configuration of arbitration after pattern NINGU of a resist by mixing the spacer which controls the thickness of a liquid crystal layer beforehand in the resist applied on a light-shielding film. Thereby, the spraying process of a spacer becomes unnecessary.

[0240] Drawing 195 is drawing showing CF substrate of the modification of the 51st example. In this example, in the 51st example, when carrying out pattern NINGU of the light-shielding film 383 and exposing it after forming Cr on the ITO film 12 and applying a resist on it, pattern NINGU also of the part of a projection which works as a domain regulation means is carried out together. And after performing development and etching, it does not exfoliate but leaves a resist as it is. Thereby, the insulating projection 387 which works as a domain regulation means is formed in the CF substrate 16. Such a CF substrate is used and the panel of structure as shown in drawing 196 is realized.

[0241] As the 47th example etc. explained, after having applied flattening agents, such as acrylic resin, after forming CF layer, and making a front face flat, the electrode 12 of the ITO film was formed with the CF substrate 16. However, this process may be skipped for simplification of a process. What does not have a layer

for such flattening is called CF substrate without topcoat. The following problems will be produced if an electrode 12 is formed without topcoat. Since a hollow is generated into the part between each CF and an anisotropy is towards a spatter when sputtering of the ITO film is carried out, the ITO film will be attached to the part of the hollow between each CF to the ITO film being densely attached to the flat part of each CF at base. For this reason, on the ITO film attached to the part of a hollow, the bigger clearance than the ITO film of a flat part will have opened.

[0242] For this reason, when applying or printing the perpendicular orientation film on CF substrate, the solvent which will be contained in the orientation film by the time it performs PURIKYUA (BEKU) after spreading/printing enters into CF layer from the part of a slot. Even if the solvent which entered prebakes, after remaining in the interior and assembling it, it comes out, and it makes an orientation film front face produce a crater etc. If a crater arises, display unevenness will occur. if protection-from-light layers, such as chromium, are prepared in the slot between each CF like the 51st example -- thereby -- CF layer of the solvent of the orientation film -- entering -- it can prevent now. In the 52nd example explained below, in order to prevent the enter lump by CF layer of the solvent of the orientation film, the resin prepared in the slot between each CF is used as a projection.

[0243] Drawing 254 is drawing showing the manufacture approach of CF substrate of the modification of the 51st example. (1) is CF substrate without topcoat, each CF layer of RGB is formed, the light-shielding film 34 is formed in the bottom of a boundary part, and, upwards, the ITO film 12 for electrodes is formed. POJIFOTOREJISUTO 389 is applied as shown in (2). As shown in (3), ultraviolet rays are irradiated from a glass substrate side, and if negatives are developed, projection 390 will be formed in the part of a light-shielding film 34 as shown in (4). Projection 390 prevents permeation in CF layer of a solvent at the time of spreading of the perpendicular orientation film. Furthermore, after being assembled, it functions as projection 20A by the side of CF substrate formed in the boundary of a pixel.

[0244] In the above, although the panel structure of the liquid crystal display of this invention was explained, the application suitable for such a panel is explained. Drawing 197 is the example of the product which used the liquid crystal display of this invention, and drawing 198 is drawing showing the configuration of this product. As shown in drawing 198, as explained until now, there is the screen 111 in a liquid crystal panel 100, and a viewing-angle property is good, and the image displayed also from the big direction to which it inclined the degree of angle can be seen in good quality only from a transverse plane, without producing tone reversal by high contrast. Behind the liquid crystal panel 100, the transilluminator 113 for making the illumination light from the light source 114 and the light source 114 into the light which illuminates a liquid crystal panel 110 uniformly is formed.

[0245] As shown in drawing 197, the part of the display screen 110 is pivotable and it can be used also as a display of a vertical mold also as a display of a horizontal type with this product according to an application. For this reason, it switches whether the switch which detects having leaned 45 degrees or more is formed, the condition of this switch is detected, and it displays as a display of a horizontal type, or it displays as a display of a vertical mold. In order to perform such a switch, the device in which read-out of the indicative data from the frame memory for image display is performed from a direction different 90 degrees etc. is required, but since the technique for it is known widely, explanation is omitted here.

[0246] The advantage at the time of applying the liquid crystal display of this invention to such a product is explained. In the conventional liquid crystal display, since an angle of visibility was narrow, when it was made the big display screen, the angle of visibility to a periphery became large, and the problem that a periphery was hard to see had produced it. However, since the display of high contrast is in sight also in a big viewing angle as for the liquid crystal display which applied this invention, without gradation being reversed, such a problem does not produce it. With a product as shown in drawing 197, an angle of visibility becomes large to a periphery with the longer display screen. Therefore, although the liquid crystal display was not able to be used for such a product, if it is the liquid crystal display of this invention, since the angle of visibility is large, it is fully applicable.

[0247] Although the example explained until now showed the equipment which mainly divides orientation into two fields to which bearings differ by a unit of 90 degrees with four fields where every 90 degrees of bearings differ, the case where these are applied to this invention is considered. Since a viewing-angle property almost good about all the directions is acquired when orientation is divided into four fields to which every 90 degrees of bearings differ, especially a problem is not produced even if it sets the direction of orientation as any. For

example, as the projection pattern shown in drawing 46 is shown in (1) of drawing 199 to a screen, when it has arranged, since a longitudinal direction and the vertical direction are 80 degrees or more, they rotate the viewing angle a display looks good, and especially a problem is not produced even if a projection pattern becomes like [on the right of drawing].

[0248] On the other hand, although the viewing-angle property of the direction which carried out orientation division improves when orientation is divided into two fields to which 180-degree bearings differ, as for a direction which is different 90 degrees in it, a viewing-angle property is seldom improved. Therefore, when a viewing-angle property almost equal to a longitudinal direction and the vertical direction is required, as shown in (2) of drawing 199, it is desirable to run a projection pattern in the direction of slanting on a screen.

[0249] Next, the production process of the liquid crystal display of this invention is explained briefly. Generally, as shown in drawing 200, the washing process 501 of a substrate, the gate electrode formation process 502, the layer continuation film formation process 503 of operation, the isolation process 504, the protective coat formation process 505, the pixel electrode formation process 506, and an assembler are performed in order of 508, but the production process of a liquid crystal panel will form the projection formation process 507 after the pixel electrode formation process 506, if an insulating projection is formed.

[0250] As shown in drawing 201, a projection formation process consists of the resist spreading process 511, the prebaking process 512 which calcinates the applied resist, a projection pattern exposure process 513 exposed so that it may leave the part of a projection, a development process 514 which removes parts other than a projection, and a postbake process 215 which calcinates the projection which remained. As the 1st example explained, it is desirable for there to be possibility that a resist will react with the orientation film with the orientation film formation process performed at a next process, and to calcinate at an elevated temperature to some extent in consideration of it in the postbake process 515. In that case, if the cross section of a projection inclines in the shape of boiled fish paste, the stability of orientation will also increase.

[0251] Also when forming a hollow as a domain regulation means, it is carried out at the almost same process, but since what is necessary is just to form a pattern which prepares a slit in a pixel electrode with the pixel electrode formation process 506 of drawing 200 in forming a slit in an electrode, the projection formation process 507 becomes unnecessary. Having been shown in drawing 201 can also form a projection pattern by printing, although it is an example in the case of forming a projection pattern by the photosensitive resist. Drawing 202 is drawing showing how to form a projection pattern in Toppan Printing. As shown in drawing 202, a projection pattern is formed in the flexible letterpress 604 made of APR resin, and this is fixed to the front face of the big roll 603 called a printing cylinder. A printing cylinder is interlocked with the ANIKKUSU roll 605, a doctor roll 606, and the printing stage 602, and is rotated. If the polyimide resin solution for projection formation is dropped on the ANIKKUSU roll 605 by the dispenser 607, it will be extended by the doctor roll 606 and the solution which the resin solution developed and developed by homogeneity on the ANIKKUSU roll 605 was imprinted by letterpress 604, and was imprinted by the heights of letterpress 604 will be imprinted by the substrate 609 on the printing stage 602. Then, baking etc. is processed. If various utilization is carried out and the approach of forming a pattern minute otherwise by printing can form a projection pattern using them, a projection pattern can be formed by low cost.

[0252] Next, impregnation processing of the liquid crystal to the liquid crystal panel after sticking a vertical substrate is explained. Although liquid crystal is poured in after sticking CF substrate and a TFT substrate like the assembler of a liquid crystal panel, as drawing 18 explained, LCD of a VA mold TFT method has narrow cel thickness, although the time amount of liquid crystal impregnation becomes long, in order to prepare a projection, the time amount of liquid crystal impregnation is long, and to shorten time amount of liquid crystal impregnation as much as possible is desired.

[0253] Drawing 203 is drawing showing the configuration of a liquid crystal injection injector. Although detailed explanation of this equipment is omitted, the impregnation connector 615 is connected to the liquid crystal inlet of a liquid crystal panel 100, and liquid crystal is supplied from the liquid crystal degassing pressure tank 614. The exhaust air connector 618 is connected to it and coincidence for the exhaust port of liquid crystal, the inside of a liquid crystal panel 100 is decompressed with the vacuum pump 620 for exhaust air, and liquid crystal makes it be easy to be poured in. The liquid crystal discharged from an exhaust port is separated with a gas by the liquid crystal trap 619.

[0254] In the 1st example, as shown in drawing 18, projection 20 is a straight line-like and was running in the direction parallel to the long side of a panel 100. Therefore, the inlet 102 of liquid crystal was established in the

shorter side of a panel perpendicular to projection 20, and the exhaust port 103 was established in the shorter side of that an inlet 102 is formed and the opposite side. As shown in (1) of drawing 204, and (2), when similarly the projection 20 is running in the direction parallel to the shorter side of a panel 100 by the shape of a straight line, the inlet 102 of liquid crystal is established in the long side of a panel perpendicular to projection 20, and, as for an exhaust port 103, it is desirable to prepare in the long side of that an inlet 102 is formed and the opposite side. Moreover, also when projection 20 is zigzag, as the inlet 102 of liquid crystal is established in the side of a panel perpendicular to the direction in which projection 20 is prolonged and it is shown in drawing 206, it is desirable [an exhaust port 103], as shown in drawing 205 to prepare in the side of that an inlet 102 is formed and the opposite side.
[0255] Here, a poor display will be caused, if air bubbles may mix at the time of impregnation of liquid crystal and air bubbles mix. When the liquid crystal and the perpendicular orientation film of a negative mold are used, it becomes a black display at the time of no electrical-potential-difference impressing, but even if air bubbles mix in liquid crystal, since the part becomes a black display, if it remains as it is, mixing of air bubbles cannot be discovered. Therefore, the electrical potential difference was impressed to the electrode, and it was made the white display, and was checking that air bubbles were not mixing because there is no part of a black display. However, since there was no electrode near the inlet of liquid crystal, even if air bubbles were mixed in this part, it was not able to discover. Since there is a possibility of it being spread someday and reducing display quality when air bubbles are in this part, it is necessary to also discover the air bubbles near an inlet. Then, an electrode 120 is formed also near [inlet 101] the outside of a viewing area 121 and the black matrix 34, and it enables it to detect mixing of air bubbles also in this part with the liquid crystal display of this invention, as shown in drawing 207.
[0256] Since the liquid crystal display of projection and become depressed and using domain regulation means, such as slit, VA method does not need to perform rubbing processing as explained until now, the contamination in a production process is reduced sharply. Therefore, there is an advantage that a part of washing process can be skipped. However, the problem of the resistance to contamination over the organic substance being weak compared with the positive type usually used, and it being especially weak to polyurethane system resin or the skin, and causing a poor display has produced the negative-mold (n mold) liquid crystal to be used. It is considered to be the cause that the specific resistance of the liquid crystal with which the poor display was polluted falls.
[0257] Then, when it was polyurethane system resin and the skin of what kind of magnitude first, it investigated whether it would become a poor display. Drawing 208 is the liquid crystal panel of VA method. After forming the perpendicular orientation film in two substrates 16 and 17, some polyurethane system resin whose magnitude is about 10 micrometers was put on one substrate, the spacer 45 was formed in one side, the sealant 101 was formed in another side, lamination and liquid crystal were poured in, and the panel was manufactured. Consequently, polyurethane system resin 700 extended area by heat and cel thickness (cel gap) formation, and the poor display by liquid crystal contamination was accepted in 15-micrometer angle in 0.5-2mm centering on breadth and polyurethane system resin 700.
[0258] The magnitude of polyurethane system resin 700 is changed and the result of having investigated the contamination area size of liquid crystal is shown in drawing 209. If it is beyond the display within 0.3mm angle on a panel and is satisfactory, it is necessary to use magnitude of polyurethane system resin below as 5-micrometer angle. This was the same also about the skin. As mentioned above, polyurethane system resin and the skin reduce the specific resistance of liquid crystal, and it generates a poor display owing to. The amount of mixing of polyurethane system resin and the relation of a fall of specific resistance were investigated. Drawing 210 is drawing showing the frequency dependent count result of the equal circuit of the liquid crystal pixel which the gate shows in drawing 211 supposing the condition of ON. A graph shows change of the effective voltage to a frequency in case resistance is 9.1x109, 9.1x1010, 9.1x1011, and 9.1x1012 in the equal circuit of a liquid crystal pixel. It turns out that the fall of the resistance of liquid crystal will produce the fall of effective voltage from now on. In the 1-60Hz frequency range related to an actual display, it turns out that the above of a display occurs in the fall of the specific resistance of triple or more figures.
[0259] Drawing 211 and drawing 212 are drawings showing by the time amount of which the charge once accumulated supposing the condition that the liquid crystal pixel holds the charge when resistance was 9.1x1010, 9.1x1011, and 9.1x1012 is discharged. In addition, an example in case only the orientation film exists is shown as reference. Since the orientation film has strong resistance and the time constant is large, it hardly

contributes to a discharge phenomenon. Drawing 212 expands and shows the part for 0.2 or less s of drawing 211. From now on, when liquid crystal resistance is low double or more figures, it will turn out that a black stain begins to appear in 60Hz.
[0260] The above thing shows becoming a problem if resistance falls figures triple [2-] by polyurethane system resin or the skin. Next, after putting a phenylurethane into liquid crystal, the supersonic wave was applied for 10 seconds, it was left after that, and the specific resistance of a supernatant was measured. This result showed that the amount of mixing of polyurethane system resin carried out by the mole ratio, and specific resistance carried out a digit extent fall about by 1/1000.
[0261] The above thing showed that display unevenness was level which does not produce a problem, when making the amount of mixing of polyurethane system resin or the skin or less into 1/1000 by the mole ratio. In order to make the amount of mixing of polyurethane system resin or the skin below into the above level, it is necessary to make into the air cleanliness class corresponding to the above-mentioned level suspension level of the polyurethane system resin in the clean room which manufactures a liquid crystal panel, or the skin. Furthermore, the process which washes a substrate front face with pure water at the front like an assembler is established.
[0262] In the above, the example of the liquid crystal display panel of VA method which divides the orientation of liquid crystal with a domain regulation means was explained. As already explained, using a phase contrast film is known as an approach of raising a viewing-angle property. Next, the property of the phase contrast film suitable for the liquid crystal display panel of VA method which quadrisects the direction of orientation of liquid crystal at an equal rate within 1 pixel as shown in drawing 55, and the example of arrangement are explained.
[0263] Drawing 213 is drawing showing the basic configuration of the liquid crystal panel of VA method. As shown in drawing 213, by pinching liquid crystal among the electrodes 12 and 13 formed on two substrates, a liquid crystal panel is realized and two polarizing plates 11 and 15 with which an absorption shaft intersects perpendicularly mutually are arranged on both sides. The liquid crystal panel used here is a liquid crystal display panel of VA method which the perpendicular orientation film is formed, the liquid crystal which has a negative dielectric constant anisotropy is used, and the 180 degrees of the directions of rubbing of the upper substrate 12 and the bottom substrate 13 are changed like illustration, and made 45 degrees to the absorption shaft of polarizing plates 11 and 15. In this equipment, the viewing-angle field which produces tone reversal for contrast curves, such as a time of seeing a panel from all bearings to 80 degrees of slant, in drawing 214 at the time of 8 gradation drives is shown in drawing 215. The contrast in bearing (0 degree, 90 degrees, 180 degrees, and 270 degrees) is low, and these results show that tone reversal arises in the quite large viewing-angle range.
[0264] As shown in drawing 216, the viewing-angle field which produces tone reversal for a contrast curve -- it can set to the liquid crystal display which used the liquid crystal panel which consists of two liquid crystal substrates 91 and 92 with which the projection pattern as shown in drawing 55 was formed -- in drawing 217 at the time of 8 gradation drives is shown in drawing 218. It can be said that this is still insufficient compared with the conventional VA method although improved about tone reversal, and it has seldom improved about contrast.

[0265] These people are Japanese Patent Application No. No. 41926 [eight to], Japanese Patent Application No. No. 29455 [nine to] which sets it as the foundation of priority, and Japanese Patent Application No. No. 259872 [eight to], and are indicating that a viewing-angle property makes it improve by preparing a phase contrast film in the liquid crystal display of VA method in which orientation division is carried out by rubbing. However, about the case where orientation division is carried out to the slit of a projection, a hollow, and a pixel electrode, reference is not made at all.
[0266] The conditions in the case of improving further the viewing-angle property in the liquid crystal display of VA method which was made to carry out orientation division within each pixel by the slit prepared in the projection, the hollow, and the electrode hereafter by preparing a phase contrast film are explained. First, the phase contrast film used in this invention is explained with reference to drawing 219. it is shown in drawing 219 -- as -- the refractive index of film plane inboard -- nx -- the refractive index of ny and the thickness direction -- nz ** -- the phase contrast film used in this invention when it carries out -- nx and ny >=nz Relation is realized.
[0267] Here, it is nx >ny =nz. It is called the phase contrast film which has optically uniaxial [forward] for the phase contrast film with which relation is realized optically in a film plane, and this film is only henceforth called a forward optically uniaxial film. A refractive index nx and ny The direction of the larger one is called a

lagging axis inside. in this case, nx >ny it is -- since -- x directions are called a lagging axis. If thickness of a phase contrast film is set to d, the retardation of R=(nx-ny) d will be produced in field inboard by passing this forward optically uniaxial film. Henceforth, when it is called the retardation of a forward optically uniaxial film, the retardation of field inboard shall be pointed out.

[0268] Moreover, nx =ny >nz It is called the phase contrast film which has optically uniaxial [negative] for the phase contrast film with which relation is realized optically in the direction of a normal of a film plane, and this film is only henceforth called a negative optically uniaxial film. If thickness of a phase contrast film is set to d, the retardation of R=(nx+ny) (/2-nz) d will be produced in the thickness direction by passing this negative optically uniaxial film. Henceforth, when it is called the retardation of a negative optically uniaxial film, the retardation of the thickness direction shall be pointed out.

[0269] Furthermore, nx >ny >nz The phase contrast film with which relation is realized is called phase contrast film which has biaxial nature, and this film is only henceforth called a biaxial nature film. in this case, nx >ny it is -- since -- x directions are called a lagging axis. When thickness of a phase contrast film is set to d, the retardation of d (nx-ny) (at however, the time of nx >ny) and the thickness direction of a film of the retardation of film plane inboard is d (/(nx+ny)2-nz).

[0270] Drawing 220 is drawing showing the configuration of the liquid crystal display of the 52nd example of this invention. A color filter and a common electrode (solid electrode) are formed in the side which faces the liquid crystal of one CF substrate of substrates 91 and 92, and the TFT component, the bus line, and the pixel electrode are formed in the side which faces the liquid crystal of the TFT substrate of another side. A perpendicular orientation ingredient is applied by decalcomania and the perpendicular orientation film is formed in the side which faces the liquid crystal of substrates 91 and 92 by calcinating by 180-degreeC. On the perpendicular orientation film, the protective material made from positive type sensitization is applied with a spin coat, and the projection pattern shown in drawing 55 is formed of Puri **-KU, exposure, and postbake.

[0271] Substrates 91 and 92 enclose the liquid crystal ingredient which is stuck through a spacer with a diameter of 3.5 micrometers and has a negative dielectric constant isomerism, and are using it as the liquid crystal panel. As shown in drawing 220, two substrates 91 and 92 with which the liquid crystal display of the 52nd example constitutes the 1st polarizing plate 11, the 1st forward optically uniaxial film 94, and a liquid crystal panel, the 2nd forward optically uniaxial film 94, and the 2nd polarizing plate 15 are arranged at this sequence. In addition, the absorption shaft of the 1st polarizing plate 11 and the lagging axis of the 1st forward optically uniaxial film 94 cross at right angles, and the lagging axis of the 2nd forward optically uniaxial film 94 is arranged so that it may intersect perpendicularly with the absorption shaft of the 2nd polarizing plate 15.

[0272] the 52nd example -- setting -- retardation R0 of the 1st and 2nd forward optically uniaxial films 94 R1 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 110nm, respectively in drawing 221 at the time of 8 gradation drives is shown in drawing 222. As compared with Fig. 217 and 218, the range where high contrast is acquired stops having produced breadth and tone reversal in all the range sharply, and the viewing-angle property has been sharply improved so that clearly.

[0273] here -- the configuration of drawing 220 -- retardation R0 of the 1st and 2nd forward optically uniaxial films 94 R1 It was made to change variously and the viewing-angle property was investigated. The approach of investigating is R0. R1 Make it change and it sets at the upper right (45-degree bearing) of a panel, the upper left (135-degree bearing), the lower left (225-degree bearing), and the lower right (315 degrees). It asks for the include angle from which contrast is set to 10, and is R0. R1 R0 from which the include angle becomes the same value on a coordinate R1 A high line chart, such as having connected the point with the line, is shown in drawing 223. In addition, the contour-line graph of the upper right of a panel, the upper left, the lower left, and the lower right was the same. Since this used the projection pattern shown in drawing 55, it is considered to be because for four fields depended comparatively to be equal by orientation.

[0274] R0 from which the include angle from which contrast becomes 10 in the bearing (45 degrees, 135 degrees, 225 degrees, and 315 degrees) is 39 degrees in drawing 217, and the include angle from which contrast is set to 10 becomes 39 degrees or more in drawing 223 R1 In combination, it can be said that it is about the effectiveness which used the phase contrast film. in drawing 223, the include angle from which contrast is set to 10 becomes 39 degrees or more -- R0 R1 It is a time of the following conditions being fulfilled.

[0275] R1 <=450 nm-R0 and R0-250 nm<=R1 <=R -- 0+250nm and 0 <=R0 0 <=R1 [and] -- retardation deltan-d of a liquid crystal cell is changed in the practical range, and a twist angle is further changed in 0 degree - 90 degrees again -- making -- the same -- R0 R1 As a result of searching for optimum conditions, it was

checked that it is not different from the above-mentioned conditions.
[0276] Drawing 224 is drawing showing the configuration of the liquid crystal display of the 53rd example of this invention. As for differing from the 52nd example, the forward optically uniaxial film, the 1st and the 2nd, 94 of two sheets is arranged between the 1st polarizing plate 11 and liquid crystal panel, and the forward optically uniaxial film 94 of two sheets is the point that the lagging axis is arranged so that the absorption shaft of the 1st polarizing plate 11 and the lagging axis of the 2nd forward optically uniaxial film which intersects perpendicularly mutually and adjoins the 1st polarizing plate 11 may cross at right angles.
[0277] the 53rd example -- setting -- phase contrast R0 and R1 of the 1st and 2nd forward optically uniaxial films 94 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 110nm and 270nm, respectively in drawing 225 at the time of 8 gradation drives is shown in drawing 226. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.
[0278] the 52nd example -- the same -- the configuration of drawing 224 -- retardation R0 of the 1st and 2nd forward optically uniaxial films 94 R1 The result of having changed variously and having investigated the viewing-angle property is shown in drawing 227. the include angle from which the property shown in drawing 227 is the same as drawing 223, and contrast is set to 10 -- R0 R1 a coordinate top -- it is -- etc. -- it considers as a high line chart. It is R0 that the include angle from which contrast is set to 10 will become 39 degrees or more from now on. R1 It is a time of the following conditions being fulfilled.
[0279]
1<=2R0+280nm of 2R0-170 nm<=R, R1 <=-R0 / 2+800nm, and 0 <=R0 And even if it changes retardation deltan-d of a liquid crystal cell in the practical range and changed the twist angle in 0 degree - 90 degrees further also in 0 <=R1 and the 53rd example, it checked that it was not different from the above-mentioned conditions.
[0280] Drawing 228 is drawing showing the configuration of the liquid crystal display of the 54th example of this invention. Differing from the 52nd example is the point that arrange the 1st negative optically uniaxial film 95 between a liquid crystal panel and the 1st polarizing plate 11, and it arranges the 2nd negative optically uniaxial film 95 between a liquid crystal panel and the 2nd polarizing plate 15.
[0281] the 54th example -- setting -- the 52nd example -- the same -- the configuration of drawing 228 -- retardation R0 of the thickness direction of the 1st and 2nd negative optically uniaxial films 95 R1 The result of having changed variously and having investigated the viewing-angle property is shown in drawing 229. the include angle from which the property shown in drawing 229 is the same as drawing 223, and contrast is set to 10 -- R0 R1 a coordinate top -- it is -- etc. -- it considers as a high line chart. It is R0 that the include angle from which contrast is set to 10 will become 39 degrees or more from now on. R1 It is a time of the following conditions being fulfilled.
[0282] R0+R -- also in the 54th example, retardation deltan-d of a liquid crystal cell was changed in the practical range, and 1<=500nm of relation between deltan-d and the upper limit of optimum conditions was investigated here. The result is shown in drawing 230. When deltan-d of a liquid crystal cell is set to RLC from this, the optimum conditions of the sum of the retardation of a Gentlemen phase reference film are less than [1.7xRLC+50nm].
[0283] Moreover, although this condition was a property about contrast, optimum conditions were similarly examined about tone reversal. the case of contrast -- the same -- the configuration of drawing 228 -- it is -- retardation R0 of the thickness direction of the 1st and 2nd negative optically uniaxial films 95 R1 the include angle which is changed variously and produces tone reversal -- asking -- R0 R1 a coordinate top -- it is -- etc. -- it is drawing 23 which was considered as the high line chart. The include angle which produces tone reversal in drawing 218 is 52 degrees. R0 from which the include angle which tone reversal produces in drawing 231 becomes 52 degrees or more On the conditions of R1, it can be said that it is about the effectiveness of a phase contrast film about tone reversal. in drawing 231, the include angle which tone reversal produces becomes 52 degrees or more -- R0 R1 ******** -- it is a time of the following conditions being fulfilled.
[0284] R0+R1 <=345nm, next retardation deltan-d of a liquid crystal cell were changed in the practical range, and the relation between deltan-d and the upper limit of optimum conditions was investigated. The result is shown in drawing 232. Almost more fixed [the upper limit of optimum conditions / without being based on deltan-d of a liquid crystal cell] than this, the optimum conditions of the sum of the retardation of a Gentlemen

phase reference film are 350nm or less.
[0285] As for the include angle from which contrast is set to 10, it is desirable that it is 50 degrees or more, and when it takes into consideration also about deltan-d of tone reversal or a practical liquid crystal cell, as for the sum of the retardation of a Gentlemen phase reference film, it is desirable that it is [30nm or more] 270nm or less. Moreover, as a result of changing a twist angle in 0 to 90 degrees and investigating it similarly, it turned out that there is no change in optimum conditions.
[0286] The 55th example removes one side of the 1st and 2nd negative optically uniaxial films 95 in the configuration of the liquid crystal display of the 54th example of drawing 228. In the 55th example, the viewing-angle field where tone reversal produces the ** contrast curve at the time of setting the retardation of the negative optically uniaxial film 95 of one sheet to 200nm in drawing 233 at the time of 8 gradation drives is shown in drawing 234. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly. Moreover, although the optimum conditions from which contrast is set to 10, and the optimum conditions about tone reversal were examined, it turned out that what is necessary is just to use negative 1 axial film of one sheet which has a retardation equivalent to the sum of the retardation of negative 1 axial film of the 54th example.
[0287] It was the example which uses the 58th example combining forward 1 axial film and negative 1 axial film from the 56th example, and although there were various kinds of modifications about the approach of arrangement, it turned out that the configuration shown in the 58th example from the 56th example is effective. Drawing 235 is drawing showing the configuration of the liquid crystal display of the 56th example of this invention. Differing from the 52nd example is a point which uses the negative 1 axial film 95 instead of the 1st forward 1 axial film 94 arranged between a liquid crystal panel and the 1st polarizing plate 11.
[0288] It sets in the 56th example and is the retardation R0 of the film plane inboard of the forward optically uniaxial film 94. Retardation R1 of the thickness direction of 150nm and the negative optically uniaxial film 95 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 150nm in drawing 236 at the time of 8 gradation drives is shown in drawing 237. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.
[0289] The 56th example also examined optimum conditions about contrast. The optimum conditions about contrast are shown in drawing 238. The contents shown in drawing 238 are the same as drawing 223. Drawing 239 is drawing showing the configuration of the liquid crystal display of the 57th example of this invention. differing from the 52nd example is a point which has arranged the forward 1 axial film 94 between a liquid crystal panel and the 1st polarizing plate 11, and has arranged the 1 axial film 95 negative to it being alike between this forward 1 axial film 94 and the 1st polarizing plate 11. The lagging axis of the forward optically uniaxial film 94 is arranged so that it may intersect perpendicularly with the absorption shaft of the 1st polarizing plate 11.
[0290] It sets in the 57th example and is the retardation R0 of the film plane inboard of the forward optically uniaxial film 94. Retardation R1 of the thickness direction of 50nm and the negative optically uniaxial film 95 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 200nm in drawing 240 at the time of 8 gradation drives is shown in drawing 241. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.
[0291] The 57th example also examined optimum conditions about contrast. The optimum conditions about contrast are shown in drawing 242. The contents shown in drawing 242 are the same as drawing 223. Drawing 243 is drawing showing the configuration of the liquid crystal display of the 58th example of this invention. differing from the 52nd example is a point which has arranged the negative 1 axial film 95 between a liquid crystal panel and the 1st polarizing plate 11, and has arranged the 1 axial film 94 forward to it being alike between this negative 1 axial film 95 and the 1st polarizing plate 11. The lagging axis of the forward optically uniaxial film 94 is arranged so that it may intersect perpendicularly with the absorption shaft of the 1st polarizing plate 11.
[0292] It sets in the 58th example and is the retardation R1 of the film plane inboard of the forward optically uniaxial film 94. Retardation R0 of the thickness direction of 150nm and the negative optically uniaxial film 95 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as

150nm in drawing 244 at the time of 8 gradation drives is shown in drawing 245. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.
[0293] The 58th example also examined optimum conditions about contrast. The optimum conditions about contrast are shown in drawing 246. The contents shown in drawing 246 are the same as drawing 223. Drawing 247 is drawing showing the configuration of the liquid crystal display of the 59th example of this invention. Differing from the 52nd example is nz about the refractive index of nx, ny, and the thickness direction in the refractive index of field inboard between a liquid crystal panel and the 1st polarizing plate 11. When it carries out, it is the point that arrange the phase contrast film 96 which has the relation of nx and ny >=nz, and the forward 1 axial film 94 between a liquid crystal panel and the 2nd polarizing plate 15 is removed. The x axis of the phase contrast film 96 is arranged so that it may intersect perpendicularly with the absorption shaft of the 1st polarizing plate 11.
[0294] It sets in the 59th example and is a lagging axis, i.e., nx >ny, about the x axis of the phase contrast film 96. The viewing-angle field where tone reversal produces the ** contrast curve at the time of carrying out and setting the retardation RYZ of 55nm and the thickness direction to 190nm for the retardation of film plane inboard in drawing 248 at the time of 8 gradation drives is shown in drawing 249. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.
[0295] Here, it is defined as RXZ=(nx-nz) d and RYZ=(ny-nz) d. Also in the 59th example, RXZ and RYZ were variously changed about contrast and optimum conditions were examined. The optimum conditions about contrast are shown in drawing 250. the contents shown in drawing 250 -- R0 R1 It is the same except corresponding to RXZ and RYZ, respectively. It is a time of the following conditions being fulfilled about RXZ and RYZ that the include angle from which contrast is set to 10 becomes 39 degrees or more from these results.
[0296] It is the retardation of R0 and the thickness direction about the retardation of the field inboard of RXZ-250 nm<=RYZ<=RXZ+150nm, RYZ<=-RXZ+1000nm, 0 <=RYZ, and the 0 <=RXZ phase contrast film 96 R1 When it carries out, it is R0 =(nx-ny) d=RXZ-RYZ. -- (at the time of nx >=ny)
R0 =(ny-nx) d=RYZ-RXZ -- (at the time of ny >=nx)
Since the relation between R1 =(nx+ny) (/2-nz) d= (RXZ+RYZ) / 2 is realized, the optimum conditions about RXZ and RYZ are rewritten as follows.
[0297] It is desirable for the phase contrast in R0 <=250nm and R1 <=500nm, i.e., a field, to arrange so that it may intersect perpendicularly with the absorption shaft of the polarizing plate with which the lagging axis of a biaxial nature phase contrast film adjoins [the phase contrast of 250nm or less and the thickness direction] by 500nm or less. As a result of changing retardation deltan-d of a liquid crystal cell in the practical range and investigating the relation between deltan-d and the upper limit of optimum conditions, it turned out that it is always 250nm or less, without basing the optimum conditions of the retardation of field inboard on deltan-d of a liquid crystal cell. On the other hand, it depends for the optimum conditions of the phase contrast of the thickness direction on deltan-d of a liquid crystal cell. The result of having investigated the relation between deltan-d of a liquid crystal cell and the upper limit of the optimal range of the retardation of the thickness direction is shown in drawing 251. When the optimum conditions of the retardation of the thickness direction set deltan-d of a liquid crystal cell to RLC from this, it is less than [1.7xRLC+50nm].
[0298] In addition, optimum conditions were similarly investigated with the configuration of drawing 247 about the configuration which has arranged two or more phase contrast films 96 at least to one side between one liquid crystal panel side, the 1st polarizing plate 11 of both sides, or the 2nd polarizing plate 15. Consequently, it turned out that the case where the retardation of the field inboard of the Gentlemen phase reference film 96 is 250nm or less, respectively, and the sum of the retardation of the thickness direction of the Gentlemen phase reference film 96 is less than [1.7xRLC+50nm] is optimum conditions.
[0299] Moreover, although the twist angle was changed in 0 degree - 90 degrees and optimum conditions were investigated similarly, each optimum conditions did not change. As a film 96, a forward optically uniaxial film (nx >ny =nz), a negative optically uniaxial film (nx =ny > nz), and an optically biaxial film (nx >ny > nz) can be considered, and independent or the case where it uses combining each is possible in the either.
[0300] As mentioned above, although the conditions of the optimal phase contrast film in the case of preparing a projection train in the side which faces the liquid crystal of two substrates which constitute a liquid crystal panel, and carrying out orientation division within a pixel were explained, also when carrying out orientation

division to the slit of a hollow or a pixel electrode, a viewing-angle property can be improved on the same conditions. Moreover, the polarizing plate in this specification is described as an ideal polarizing plate. Therefore, the retardation (the phase contrast of the thickness direction is usually about 50nm) of what it should compound with the retardation which the phase contrast film of this invention has, and should be treated which the film (TAC film) which is used with the configuration of an actual polarizing plate, and which protects a polarizer has is obvious.

[0301] That is, although arrangement of a phase contrast film can be seemingly lost by making a TAC film possess the conditions in this invention, it cannot be overemphasized that a TAC film acts on the phase contrast film to which this invention should be added, and an EQC in this case. As mentioned above, although the example of this invention was explained, otherwise to this invention, various kinds of deformation is possible, and there may be various kinds of modifications according to the liquid crystal display which especially applies a projection pattern, a configuration, etc.

[0302] As mentioned above, although the example which applied this invention to the TFT mold liquid crystal display was explained, this invention is applicable also to liquid crystal displays other than this. For example, it can apply also to LCD of the MOS-FET method instead of TFT used as a reflective mold, and the method which used diodes, such as an MIM component, as an active element, and can apply to what uses an amorphous silicon also by the TFT method, and both which use polish recon. Moreover, it is applicable not only to LCD of a transparency mold but a reflective mold and plasma addressing.

[Translation done.]

Drawings are not displayable due to the volume of the data (more than 200 drawings).

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing explaining the panel structure and the principle of operation of the TN mold LCD.
[Drawing 2] It is drawing explaining change of the image by the angle of visibility of the TN mold LCD.
[Drawing 3] It is drawing explaining the IPS mold LCD.
[Drawing 4] It is drawing showing the definition of the coordinate meter in the observation which made the IPS mold LCD the example.
[Drawing 5] It is drawing showing the tone reversal field in the IPS mold LCD.
[Drawing 6] It is drawing showing the change and tone reversal of gradation in the IPS mold LCD.
[Drawing 7] It is drawing explaining VA (Vertically aligned) method and its trouble.
[Drawing 8] It is the explanatory view of rubbing processing.
[Drawing 9] It is drawing explaining the principle of this invention.
[Drawing 10] It is drawing explaining generation of the orientation by projection.
[Drawing 11] It is drawing showing the example of a configuration of a projection.
[Drawing 12] It is drawing showing the method which realizes liquid crystal orientation of this invention.
[Drawing 13] It is drawing showing the whole liquid crystal panel configuration of the 1st example.
[Drawing 14] It is drawing showing the panel structure of the 1st example.
[Drawing 15] It is drawing showing the projection pattern of the 1st example.
[Drawing 16] It is drawing showing the projection pattern of the periphery in the 1st example.
[Drawing 17] It is a panel sectional view in the 1st example.
[Drawing 18] It is drawing showing arrangement of the liquid crystal inlet of the panel of the 1st example.
[Drawing 19] It is drawing showing the actual measurement of the projection configuration of the 1st example.
[Drawing 20] It is drawing showing the speed of response in the 1st example.
[Drawing 21] It is drawing showing the speed of response in the 1st example.
[Drawing 22] It is drawing showing the viewing-angle property in the 1st example.
[Drawing 23] It is drawing showing the viewing-angle property in the 1st example.
[Drawing 24] It is drawing showing the viewing-angle property in the 1st example.
[Drawing 25] It is drawing showing the viewing-angle property at the time of using a phase contrast film in the 1st example.
[Drawing 26] It is drawing showing the viewing-angle property at the time of using a phase contrast film in the 1st example.
[Drawing 27] It is drawing explaining generating of the leakage light in a projection part.
[Drawing 28] It is drawing showing change of the permeability when changing the height of a projection in the 1st example.
[Drawing 29] It is drawing showing change of the contrast when changing the height of a projection in the 1st example.
[Drawing 30] It is drawing showing the relation between the height of a projection in the 1st example, and the permeability of confession voice.
[Drawing 31] It is drawing showing the relation between the height of a projection in the 1st example, and the permeability of a black condition.
[Drawing 32] It is drawing showing the height of a projection in the 1st example, and the relation of a contrast

ratio.
[Drawing 33] It is drawing showing the projection pattern of the 2nd example.
[Drawing 34] It is drawing showing the projection pattern of the 3rd example.
[Drawing 35] It is drawing showing other examples of the projection pattern of the 3rd example.
[Drawing 36] It is drawing showing the orientation of the liquid crystal molecule on a projection.
[Drawing 37] It is drawing showing the projection configuration of the 4th example.
[Drawing 38] It is drawing showing the panel structure of the 5th example.
[Drawing 39] It is drawing showing the pixel electrode pattern of the 5th example.
[Drawing 40] It is drawing showing the example of the orientation distribution in a slit connection.
[Drawing 41] It is drawing showing a projection in the 5th example, and generating of the domain in the slit section.
[Drawing 42] It is drawing showing the configurations of a projection in the 6th example, and the slit of an electrode.
[Drawing 43] It is drawing showing a projection in the 6th example, and generating of the domain in the slit section.
[Drawing 44] It is drawing showing the top view of the picture element part in the liquid crystal display of the 6th example.
[Drawing 45] It is drawing showing the pixel electrode pattern of the 6th example.
[Drawing 46] It is the sectional view of the picture element part of the 6th example.
[Drawing 47] It is drawing showing the viewing-angle property in the 6th example.
[Drawing 48] It is drawing showing the viewing-angle property in the 6th example.
[Drawing 49] It is drawing showing the modification of the pixel electrode pattern of the 6th example.
[Drawing 50] It is drawing showing the pixel electrode pattern and structure of the 7th example of this invention.
[Drawing 51] It is drawing showing the top view of the picture element part in the liquid crystal display of the 8th example of this invention.
[Drawing 52] It is the sectional view of the picture element part of the 8th example.
[Drawing 53] It is drawing explaining the manufacture approach of the TFT substrate in the 8th example.
[Drawing 54] It is drawing explaining the manufacture approach of the TFT substrate in the 8th example.
[Drawing 55] It is drawing showing the projection pattern of the 9th example of this invention.
[Drawing 56] It is the top view of the picture element part of the 9th example.
[Drawing 57] It is drawing showing the modification of the projection pattern of the 9th example.
[Drawing 58] It is drawing showing the effect of the slanting electric field in an electrode edge.
[Drawing 59] It is drawing showing the problem in the case of using the projection which made zigzag crooked.

[Drawing 60] It is drawing showing the orientation of the electrode edge section in the case of using the projection which made zigzag crooked.
[Drawing 61] When using the projection which made zigzag crooked, it is drawing showing the part to which a speed of response falls.
[Drawing 62] When using the projection which made zigzag crooked, it is the cross section of ****** to which a speed of response falls.
[Drawing 63] It is drawing showing the basic configuration of the 10th example of this invention.
[Drawing 64] It is drawing showing the projection train pattern in the 10th example.
[Drawing 65] It is the detail drawing of the description part in the 10th example.
[Drawing 66] It is drawing explaining change of the direction of orientation by the exposure of ultraviolet rays.
[Drawing 67] It is drawing showing the modification of the 10th example.
[Drawing 68] It is drawing showing the relation between a desirable edge and a projection.
[Drawing 69] It is drawing showing the relation between a desirable edge and a hollow.
[Drawing 70] It is drawing showing desirable straight-line-like array of a projection.
[Drawing 71] It is drawing showing the projection pattern in the 11th example of this invention.
[Drawing 72] It is drawing showing the example which prepared the projection of discontinuity for every pixel.
[Drawing 73] It is drawing showing the projection pattern in the 12th example of this invention.
[Drawing 74] It is drawing showing the modification of the 12th example.

[Drawing 75] It is drawing showing the modification of the 12th example.
[Drawing 76] It is drawing showing the projection pattern in the 13th example of this invention.
[Drawing 77] It is the sectional view of the 3rd example.
[Drawing 78] It is drawing showing an operation and electrode structure of auxiliary capacity.
[Drawing 79] It is drawing showing the projection pattern and CS electrode of the 14th example of this invention.
[Drawing 80] It is drawing showing the modification of the 14th example.
[Drawing 81] It is drawing showing the modification of the 14th example.
[Drawing 82] It is drawing showing the modification of the 14th example.
[Drawing 83] It is drawing showing the projection pattern of the 15th example of this invention.
[Drawing 84] It is drawing explaining orientation change of the liquid crystal in the 15th example.
[Drawing 85] It is drawing showing the viewing-angle property in the 15th example.
[Drawing 86] It is drawing showing the halftone speed of response of TN method for the speed of response of the halftone in the 15th example, and a comparison.
[Drawing 87] It is drawing showing the speed of response of the halftone of other VA methods.
[Drawing 88] It is drawing showing the modification of the projection pattern of the 15th example.
[Drawing 89] It is drawing showing the modification of the projection pattern of the 15th example.
[Drawing 90] It is drawing showing the modification of the projection pattern of the 15th example.
[Drawing 91] It is drawing showing the modification of the projection pattern of the 15th example.
[Drawing 92] It is drawing showing the projection structure of the 16th example of this invention.
[Drawing 93] It is drawing showing the projection pattern of the 16th example.
[Drawing 94] It is drawing showing the panel structure of the 17th example of this invention.
[Drawing 95] It is drawing showing the panel structure of the 18th example of this invention.
[Drawing 96] It is drawing showing the panel structure of the 19th example of this invention.
[Drawing 97] It is drawing showing the panel structure of the 20th example of this invention.
[Drawing 98] It is drawing showing the panel structure of the modification of the 20th example.
[Drawing 99] It is drawing showing the panel structure of the modification of the 20th example.
[Drawing 100] It is drawing showing the panel structure of the modification of the 20th example.
[Drawing 101] It is drawing showing the panel structure of the 21st example of this invention.
[Drawing 102] It is drawing showing the effect on the orientation division by the panel sectional view and assembly which have a projection.
[Drawing 103] It is drawing showing the panel structure of the 22nd example of this invention.
[Drawing 104] It is drawing showing the panel structure of the 23rd example of this invention.
[Drawing 105] It is drawing showing the panel structure of the 24th example of this invention.
[Drawing 106] It is drawing showing the projection pattern adapting the structure of the 24th example.
[Drawing 107] It is drawing showing the panel structure of the 25th example of this invention.
[Drawing 108] It is drawing showing the structure of the panel which measures the relation between a projection gap and a speed of response.
[Drawing 109] It is drawing showing the relation between a projection gap and a speed of response.
[Drawing 110] It is drawing showing the relation between a projection gap and permeability.
[Drawing 111] It is the explanatory view of the principle of operation of the 25th example.
[Drawing 112] It is drawing showing the panel structure of the 26th example of this invention.
[Drawing 113] It is drawing showing the viewing-angle property of the panel of the 26th example.
[Drawing 114] It is drawing showing the usual projection pattern.
[Drawing 115] It is drawing showing the wavelength dispersion of the optical anisotropy of liquid crystal.
[Drawing 116] It is drawing showing the projection pattern of the 27th example of this invention.
[Drawing 117] It is drawing showing the difference by the projection gap of the relation between applied voltage and permeability.
[Drawing 118] It is drawing showing the projection pattern of the 28th example of this invention.
[Drawing 119] It is drawing showing the projection pattern of the 29th example of this invention.
[Drawing 120] It is drawing showing the pixel structure of the 29th example.
[Drawing 121] It is drawing showing the projection configuration of the 30th example of this invention.
[Drawing 122] It is drawing showing change of the permeability when changing the height of a projection.

[Drawing 123] It is drawing showing change of the contrast when changing the height of a projection.
[Drawing 124] It is drawing showing the relation between the height of a projection, and the permeability of confession voice.
[Drawing 125] It is drawing showing the relation between the height of a projection, and the permeability of a black condition.
[Drawing 126] It is drawing showing the modification of the 30th example.
[Drawing 127] It is drawing showing the projection configuration of the 31st example of this invention.
[Drawing 128] It is drawing showing the relation of the thickness of the twist angle of the liquid crystal panel of VA method, and a liquid crystal layer.
[Drawing 129] It is drawing showing the relative luminance of a white display of the liquid crystal panel of VA method, and the relation of retardation deltand of liquid crystal.
[Drawing 130] It is drawing showing the square-corrugated length transmission of the liquid crystal panel of VA method, and the relation of retardation deltand of liquid crystal.
[Drawing 131] It is drawing showing the gap of the liquid crystal panel of an orientation division VA method, and the relation of a speed of response.
[Drawing 132] It is drawing showing the gap of the liquid crystal panel of an orientation division VA method, and the relation of a numerical aperture.
[Drawing 133] It is drawing showing the panel structure of the 32nd example of this invention.
[Drawing 134] It is drawing showing the panel structure of the modification of the 32nd example.
[Drawing 135] It is drawing showing the structure of the TFT substrate of the 33rd example of this invention.
[Drawing 136] It is drawing showing the projection pattern of the 33rd example.
[Drawing 137] It is drawing showing the panel structure of the 34th example of this invention.
[Drawing 138] It is drawing showing the projection pattern of the 34th example.
[Drawing 139] It is drawing showing the manufacture approach of the TFT substrate of the 35th example of this invention.
[Drawing 140] It is drawing showing the structure of the TFT substrate of the modification of the 35th example.

[Drawing 141] It is drawing showing the manufacture approach of the TFT substrate of the 36th example of this invention.
[Drawing 142] It is drawing explaining the problem by the dielectric on an electrode.
[Drawing 143] It is drawing showing the projection structure of the 37th example of this invention.
[Drawing 144] It is drawing showing the manufacture approach of a projection of the 37th example.
[Drawing 145] It is drawing showing the projection structure of the 38th example of this invention.
[Drawing 146] It is drawing showing change of the projection configuration by baking.
[Drawing 147] It is drawing showing change of the cross-section configuration of the resist by burning temperature.
[Drawing 148] It is drawing showing the relation between line breadth and the cross-section configuration of a resist.
[Drawing 149] It is drawing showing the problem in the situation of a height, and spreading of the orientation film.
[Drawing 150] It is drawing showing an example of the projection manufacture approach of the 39th example of this invention, and the manufactured projection.
[Drawing 151] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 152] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 153] It is the graph which shows reforming by ultraviolet-rays exposure of a resist.
[Drawing 154] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 155] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 156] It is drawing showing other examples of the projection manufacture approach of the 39th example.

[Drawing 157] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 158] It is drawing showing the temperature-change conditions of the approach of drawing 157.
[Drawing 159] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 160] It is drawing showing the panel structure of the conventional example of having a black matrix.
[Drawing 161] It is drawing showing the panel structure of the 40th example of this invention.
[Drawing 162] It is drawing showing the projection pattern of the 40th example.
[Drawing 163] It is drawing showing the protection-from-light pattern (black matrix) of the 41st example of this invention.
[Drawing 164] It is the sectional view of the 41st example.
[Drawing 165] It is drawing showing the pixel and projection pattern of the 42nd example of this invention.
[Drawing 166] It is drawing showing the conventional panel structure where the spacer was formed.
[Drawing 167] It is drawing showing the panel structure of the 43rd example and modification of this invention.

[Drawing 168] It is drawing showing the panel structure of the modification of the 43rd example.
[Drawing 169] It is drawing showing the panel structure of the modification of the 43rd example.
[Drawing 170] It is drawing showing the manufacture approach of the liquid crystal panel of the 44th example of this invention.
[Drawing 171] It is drawing showing the spraying consistency of a spacer and the relation of a cel gap to the 44th example.
[Drawing 172] It is drawing showing the relation of generating of the unevenness when applying the spraying consistency and force of a spacer in the liquid crystal panel of the 44th example.
[Drawing 173] It is drawing showing the chemical formula of the charge of add-in material for giving the ion adsorption capacity force to a projection.
[Drawing 174] It is drawing showing the chemical formula of the charge of add-in material for giving the ion adsorption capacity force to a projection.
[Drawing 175] It is drawing showing the structure of CF substrate of the 45th example of this invention.
[Drawing 176] It is drawing showing the panel structure of the 46th example of this invention.
[Drawing 177] It is drawing showing the structure of CF substrate of the modification of the 46th example.
[Drawing 178] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 179] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 180] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 181] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 182] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 183] It is drawing showing a projection and the BM formation approach of CF substrate of the 47th example of this invention.
[Drawing 184] It is drawing showing a projection and the BM formation approach of CF substrate of the 47th example.
[Drawing 185] It is drawing showing the panel structure of the 47th example.
[Drawing 186] It is drawing showing the BM manufacture approach of CF substrate of the 48th example of this invention.
[Drawing 187] It is drawing showing the panel structure of the 48th example.
[Drawing 188] It is drawing showing the manufacture approach of CF substrate of the 49th example of this invention.
[Drawing 189] It is drawing showing the panel structure of the 49th example.
[Drawing 190] It is drawing showing the manufacture approach of CF substrate of the 50th example of this invention.

[Drawing 191] It is drawing showing the panel structure of the 50th example.
[Drawing 192] It is drawing showing the structure of CF substrate of the 51st example of this invention.
[Drawing 193] It is drawing showing the modification of the 51st example.
[Drawing 194] It is drawing showing the modification of the 51st example.
[Drawing 195] It is drawing showing the modification of the 51st example.
[Drawing 196] It is drawing showing the modification of the 51st example.
[Drawing 197] It is drawing showing the display adapting the liquid crystal panel of this invention.
[Drawing 198] It is drawing showing the configuration of the display in the application of the liquid crystal panel of this invention.
[Drawing 199] It is drawing showing rotation of the projection pattern in the application of the liquid crystal panel of this invention.
[Drawing 200] It is the flow chart which shows the production process of the liquid crystal panel of this invention.
[Drawing 201] It is the flow chart which shows the projection formation process of the liquid crystal panel of this invention.
[Drawing 202] It is drawing showing the configuration of the equipment for forming a projection by printing.
[Drawing 203] It is drawing showing the configuration of a liquid crystal injector.
[Drawing 204] It is drawing showing the example of arrangement of the inlet to a projection with the liquid crystal panel of this invention.
[Drawing 205] It is drawing showing the example of arrangement of the inlet to a projection with the liquid crystal panel of this invention.
[Drawing 206] It is drawing showing the example of arrangement of the inlet to a projection with the liquid crystal panel of this invention.
[Drawing 207] It is drawing showing the electrode structure near the inlet in the liquid crystal panel of this invention.
[Drawing 208] It is drawing showing generating of the abnormalities in a display when polyurethane system resin mixes with the liquid crystal panel of this invention.
[Drawing 209] It is drawing showing the relation between the magnitude of polyurethane system resin, and liquid crystal contamination area size.
[Drawing 210] It is drawing showing the simulation result which shows the fall of effective voltage to the frequency by the difference of specific resistance.
[Drawing 211] It is drawing showing the simulation result of the charging time value of the charge by the difference of specific resistance.
[Drawing 212] It is drawing showing the simulation result of the charging time value of the charge by the difference of specific resistance.
[Drawing 213] It is drawing showing the configuration of the liquid crystal display of VA method.
[Drawing 214] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of VA method.
[Drawing 215] It is drawing showing the viewing-angle field which tone reversal produces in the liquid crystal display of VA method.
[Drawing 216] It is drawing showing the configuration of the display which used new VA method panel which has a domain regulation means.
[Drawing 217] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of new VA method.
[Drawing 218] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of new VA method.
[Drawing 219] It is drawing explaining the property of a phase contrast film.
[Drawing 220] It is drawing showing the configuration of the liquid crystal display of the 52nd example of this invention.
[Drawing 221] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 52nd example.
[Drawing 222] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 52nd example.

[Drawing 223] It is drawing showing the change to the amount of phase contrast of the include angle from which the contrast seen from the slant in the liquid crystal display of the 52nd example becomes a predetermined value.
[Drawing 224] It is drawing showing the configuration of the liquid crystal display of the 53rd example of this invention.
[Drawing 225] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 53rd example.
[Drawing 226] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 53rd example.
[Drawing 227] It is drawing showing the change to the amount of phase contrast of the include angle from which the contrast seen from the slant in the liquid crystal display of the 53rd example becomes a predetermined value.
[Drawing 228] It is drawing showing the configuration of the liquid crystal display of the 54th example of this invention.
[Drawing 229] It is drawing showing the change to the amount of phase contrast of the include angle from which the contrast seen from the slant in the liquid crystal display of the 54th example becomes a predetermined value.
[Drawing 230] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 54th example.
[Drawing 231] It is drawing showing the change to the amount of phase contrast of the marginal angle which does not produce tone reversal in the liquid crystal display of the 54th example.
[Drawing 232] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the tone reversal in the liquid crystal display of the 54th example.
[Drawing 233] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 55th example of this invention.
[Drawing 234] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 55th example.
[Drawing 235] It is drawing showing the configuration of the liquid crystal display of the 56th example of this invention.
[Drawing 236] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 56th example.
[Drawing 237] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 56th example.
[Drawing 238] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 56th example.
[Drawing 239] It is drawing showing the configuration of the liquid crystal display of the 57th example of this invention.
[Drawing 240] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 57th example.
[Drawing 241] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 57th example.
[Drawing 242] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 57th example.
[Drawing 243] It is drawing showing the configuration of the liquid crystal display of the 58th example of this invention.
[Drawing 244] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 58th example.
[Drawing 245] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 58th example.
[Drawing 246] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 58th example.
[Drawing 247] It is drawing showing the configuration of the liquid crystal display of the 59th example of this invention.

[Drawing 248] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 59th example.
[Drawing 249] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 59th example.
[Drawing 250] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 59th example.
[Drawing 251] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 59th example.
[Drawing 252] It is drawing showing the measurement result of the property of the liquid crystal panel of the 32nd example of this invention.
[Drawing 253] It is drawing showing change of the ion density when performing processing which gives the ion adsorption capacity force to a projection.
[Drawing 254] It is drawing showing the manufacture approach of the liquid crystal panel of the modification of the 51st example of this invention.
[Drawing 255] It is drawing showing the projection pattern and cross-section structure of a modification of the 2nd example.
[Drawing 256] It is drawing showing the projection pattern of the modification of the 2nd example.
[Drawing 257] It is drawing showing the projection pattern and cross-section structure of a modification of the 16th example.
[Drawing 258] It is drawing showing arrangement of the auxiliary projection in the modification of the 10th example.
[Description of Notations]
9 -- Pixel
11 15 -- Polarizing plate
12 -- CF lateral electrode
13 -- Pixel electrode
14 -- Liquid crystal molecule
16 17 -- Glass substrate
18 19 -- Electrode
20, 20A, 20B -- Domain regulation means (projection)
21 -- Domain regulation means (slit)
22 -- Perpendicular orientation film
23 -- Domain regulation means (hollow)
31 -- Gate bus
32 -- Address bus
33 -- TFT
34 -- Light-shielding film
35 -- CS electrode
41 -- Source
42 -- Drain
45 -- Spacer

[Translation done.]

Drawings are not displayable due to the volume of the data (more than 200 drawings).

[Translation done.]

Drawings are not displayable due to the volume of the data (more than 200 drawings).

WRITTEN AMENDMENT

-- [a procedure revision]
[Filing Date] January 25, Heisei 11
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Whole sentence
[Method of Amendment] Modification
[Proposed Amendment]
[Document Name] Specification
[Title of the Invention] Liquid crystal display
[Claim(s)]
[Claim 1] In the liquid crystal display of the orientation which becomes almost level when a dielectric constant anisotropy pinches negative liquid crystal and the orientation of said liquid crystal impresses a predetermined electrical potential difference almost perpendicularly at the time of no electrical-potential-difference impressing between the 1st [which performed perpendicular orientation processing to the substrate front face], and 2nd two substrates, and becomes slanting when an electrical potential difference smaller than said predetermined electrical potential difference is impressed,
The 1st domain regulation means which regulates the direction of orientation where said liquid crystal becomes slanting when it is prepared in said 1st substrate and an electrical potential difference smaller than said predetermined electrical potential difference is impressed,
It is prepared in said 2nd substrate, and when an electrical potential difference smaller than said predetermined electrical potential difference is impressed, it has the 2nd domain regulation means which regulates the direction of orientation where said liquid crystal becomes slanting,
At least, said 1st domain regulation means is established on the electrode of said 1st substrate, and is equipped with the projection of the dielectric which projects to the direction of the layer of said liquid crystal which makes a slant face a part of contact surface with said liquid crystal of said 1st substrate,
It is the liquid crystal display characterized by meeting in the direction of orientation at the time of no electrical-potential-difference impressing the liquid crystal near [said] a slant face when carrying out orientation of the liquid crystal near [said] a slant face almost at right angles to the slant face concerned and changing from electrical-potential-difference the condition of not impressing, in the electrical-potential-difference impression condition, and determining the direction of orientation of surrounding liquid crystal at the time of no electrical-potential-difference impressing.
[Claim 2] It is a liquid crystal display according to claim 1,
The pixel electrode is formed in said 2nd substrate,
Said projection is a liquid crystal display which is the projection train of the shape of two or more straight line arranged in parallel in the predetermined pitch.
[Claim 3] It is a liquid crystal display according to claim 2,
Said predetermined pitch is the same as the array pitch of said pixel electrode,
Said projection is a liquid crystal display arranged so that it may pass through the core of said pixel electrode, when it extends in parallel with the side of said pixel electrode and sees from the field of said substrate.

[Claim 4] It is a liquid crystal display according to claim 1,
The pixel electrode is formed in said 2nd substrate,
Said projection is a liquid crystal display which is the punctiform projection prepared so that the core of said pixel electrode might be countered.
[Claim 5] It is a liquid crystal display according to claim 1,
In addition to the projection of the dielectric prepared on the electrode of said 1st substrate, said 1st domain regulation means is a liquid crystal display which has the depressed hollow.
[Claim 6] It is a liquid crystal display according to claim 5,
Said projection and hollow are a liquid crystal display arranged in parallel in the predetermined pitch by turns.
[Claim 7] It is a liquid crystal display according to claim 1,
The surface ratio within each pixel of said domain regulation means is a liquid crystal display which is 50 or less %.
[Claim 8] It is a liquid crystal display according to claim 1,
Said 2nd domain regulation means is a liquid crystal display which is the 2nd structure with which it is prepared in said 2nd substrate, and is made for a part of contact surface with said liquid crystal of said 2nd substrate to turn into a slant face.
[Claim 9] It is a liquid crystal display according to claim 8,
Said 2nd structure is a liquid crystal display which is the dielectric prepared on the electrode of said 2nd substrate.
[Claim 10] It is a liquid crystal display according to claim 9,
Said 2nd structure is a liquid crystal display which is the projection which projected to the layer of said liquid crystal.
[Claim 11] It is a liquid crystal display according to claim 9,
Said 2nd structure is a liquid crystal display which is the hollow dented to the layer of said liquid crystal.
[Claim 12] It is a liquid crystal display according to claim 9,
Said 2nd structure is the projection which is prepared in said 2nd substrate and makes a slant face a part of contact surface with said liquid crystal of said 2nd substrate, and a liquid crystal display which is the group of a hollow.
[Claim 13] It is a liquid crystal display according to claim 12,
Said projection and said hollow of said 1st and 2nd domain regulation means are arranged by the spacing ratio of 1 to 3 in parallel in each substrate,
Said projection and said hollow of said 1st and 2nd substrates are a liquid crystal display with which said projections and said hollows of a substrate which counters the part of large spacing mutually and is different in parallel approach, and are arranged.
[Claim 14] It is a liquid crystal display according to claim 1,
Said 2nd domain regulation means is a liquid crystal display which is the slit prepared in the electrode on said 2nd substrate.
[Claim 15] It is a liquid crystal display according to claim 8,
A projection and said 2nd structure of said 1st domain regulation means are a liquid crystal display formed also in the part in which the pixel of the periphery of the liquid crystal display concerned does not exist.
[Claim 16] It is a liquid crystal display according to claim 9,
A projection and said 2nd structure of said 1st domain regulation means are a liquid crystal display formed by the photosensitive resist.
[Claim 17] It is a liquid crystal display according to claim 16,
Said photosensitive resist is a liquid crystal display which is a novolak system resist.
[Claim 18] It is a liquid crystal display according to claim 16,
Said photosensitive resist is a liquid crystal display by which baking processing is carried out after pattern formation. [Claim 19] It is a liquid crystal display according to claim 9,
The electric capacity value of the projection of said 1st domain regulation means and said 2nd structure is a liquid crystal display which is a 10 or less times [of the electric capacity value of directly under / of this projection /, or a nearby liquid crystal layer] value.
[Claim 20] It is a liquid crystal display according to claim 9,
The projection of said 1st domain regulation means and the specific resistance of said 2nd structure are a liquid

crystal display which is more than the specific resistance of said liquid crystal.
[Claim 21] It is a liquid crystal display according to claim 10,
The projection of said 1st and 2nd domain regulation means is a liquid crystal display currently made from the ingredient which does not pass the light.
[Claim 22] It is a liquid crystal display according to claim 10,
The projection of said 1st and 2nd domain regulation means is a liquid crystal display equipped with the hollow which has an inclination in the die-length direction.
[Claim 23] It is a liquid crystal display according to claim 10,
The liquid crystal display with which the projection which has an inclination is prepared in the die-length direction at the part after that said 1st and 2nd domain regulation means project.
[Claim 24] It is a liquid crystal display according to claim 10,
The liquid crystal display with which the center of a projection of said 1st and 2nd domain regulation means is dented.
[Claim 25] It is a liquid crystal display according to claim 10,
The projection of said 1st and 2nd domain regulation means is a liquid crystal display which has many holes where the depth to near is very small on the front face of said electrode.
[Claim 26] It is a liquid crystal display according to claim 9,
A projection and said 2nd structure of said 1st domain regulation means are a liquid crystal display which has the ion adsorption capacity force.
[Claim 27] It is a liquid crystal display according to claim 26,
A projection and said 2nd structure of said 1st domain regulation means are a liquid crystal display currently formed with the ingredient with which the ingredient which has the ion adsorption capacity force was added.
[Claim 28] It is a liquid crystal display according to claim 10,
The liquid crystal display with which surface treatment for making formation of the perpendicular orientation film easy is performed to the front face of a projection of said 1st and 2nd domain regulation means.
[Claim 29] It is a liquid crystal display according to claim 28,
Said surface treatment is a liquid crystal display which is the processing which forms irregularity in the front face of said projection.
[Claim 30] It is a liquid crystal display according to claim 28,
Said projection is made from the photosensitive resist,
Said surface treatment is a liquid crystal display which is the processing which irradiates ultraviolet rays on the front face of said projection.
[Claim 31] It is a liquid crystal display according to claim 28,
Said projection is a liquid crystal display currently made from the ingredient with which the particle was distributed.
[Claim 32] It is a liquid crystal display according to claim 28,
The liquid crystal display with which the silane system coupling agent is applied to the front face of said projection.
[Claim 33] It is a liquid crystal display according to claim 9,
A projection and said 2nd structure of said 1st domain regulation means are a liquid crystal display formed of printing.
[Claim 34] It is a liquid crystal display according to claim 10,
The diameter of the spherical spacer which specifies the thickness of said liquid crystal is a liquid crystal display which is the value which subtracted the height of a projection of said 1st and 2nd domain regulation means from the value of a request of said liquid crystal layer.
[Claim 35] It is a liquid crystal display according to claim 34,
The range of the rate of the area occupied to the screen of said projection is 1/10 to 1/2,
Said spherical spacer has 0.3-micrometer particle size distribution from the standard deviation of 0.10 micrometers, and is 2 300 pieces/mm from 150. Liquid crystal display currently sprinkled by the consistency.
[Claim 36] It is a liquid crystal display according to claim 34,
A degree of hardness is higher than said spherical spacer, and the ingredient which forms said projection is a liquid crystal display with a large elastic modulus.
[Claim 37] It is a liquid crystal display according to claim 9,

A projection and said 2nd structure of said 1st domain regulation means are a liquid crystal display which has at least the layer formed in other parts and coincidence of the liquid crystal display concerned.
[Claim 38] It is a liquid crystal display according to claim 37,
The structure by the side of the TFT substrate with which an active element is formed the projection of said 1st domain regulation means and among said 2nd structure is a liquid crystal display which has the layer which insulates an active element or a bus line.
[Claim 39] It is a liquid crystal display according to claim 37,
The projection of said 1st domain regulation means is formed in the color filter substrate side which counters the side in which an active element is formed,
This projection is a liquid crystal display formed with the same ingredient as the black matrix for shading the part of between the pixel electrode prepared on the substrate of said two upper and lower sides, and bus lines, or an active element.
[Claim 40] It is a liquid crystal display according to claim 37,
Said 2nd structure is the projection formed in the color filter substrate side which counters the side in which an active element is formed,
The projection of this 2nd structure is a liquid crystal display formed with the same ingredient as the black matrix for shading the part of between the pixel electrode prepared on the substrate of said two upper and lower sides, and bus lines, or an active element.
[Claim 41] It is a liquid crystal display according to claim 39 or 40,
The projection by the side of said color filter substrate is a liquid crystal display with which a part of charge [at least] of color filter formation material is lapped and formed mutually.
[Claim 42] It is a liquid crystal display according to claim 39 or 40,
The projection by the side of said color filter substrate is a liquid crystal display with which a part of charge [at least] of color filter formation material is prepared by using as a mask the part which lapped mutually corresponding to this ******** part.
[Claim 43] It is a liquid crystal display according to claim 37,
The projection of said 1st domain regulation means is formed in the color filter substrate side which counters the side in which an active element is formed,
The electrode by the side of said color filter substrate is directly formed on the color filter,
The projection of said 1st domain regulation means is a liquid crystal display currently formed in the boundary part of said color filter on said electrode.
[Claim 44] It is a liquid crystal display according to claim 37,
Said 2nd structure is the projection formed in the color filter substrate side which counters the side in which an active element is formed,
The electrode by the side of said color filter substrate is directly formed on the color filter,
The projection of said 2nd structure is a liquid crystal display currently formed in the boundary part of said color filter on said electrode.
[Claim 45] It is a liquid crystal display according to claim 10,
Said 1st and 2nd domain regulation means are liquid crystal displays further equipped with the projection prepared in the periphery of each pixel.
[Claim 46] It is a liquid crystal display according to claim 45,
The projection prepared in the periphery of each of said pixel is a liquid crystal display currently made from the protection-from-light member.
[Claim 47] It is a liquid crystal display according to claim 45 or 46,
The projection prepared in the periphery of each of said pixel is a liquid crystal display which specifies spacing between said two substrates.
[Claim 48] It is a liquid crystal display given in any 1 term of claims 45-47,
The projection prepared in the periphery of each of said pixel is a liquid crystal display formed in a part of periphery of each pixel.
[Claim 49] It is a liquid crystal display according to claim 10,
One height of a projection of said 1st and 2nd domain regulation means is a liquid crystal display with which it is the thickness of a request of the layer of said liquid crystal, and one side of a projection of said 1st and 2nd domain regulation means regulates the thickness of the layer of said liquid crystal.

[Claim 50] It is a liquid crystal display according to claim 10,
The projection of said 1st and 2nd domain regulation means is a liquid crystal display which is arranged so that the sum of the height of a projection of said 1st and 2nd domain regulation means may be the thickness of a request of the layer of said liquid crystal and at least a part may lap, and regulates the thickness of the layer of said liquid crystal.
[Claim 51] It is a liquid crystal display according to claim 14,
The electrode on said 2nd substrate is a pixel electrode,
This pixel electrode is a liquid crystal display equipped with two or more partial electrodes divided to the slit, and the electrical installation part which connects this partial electrode electrically.
[Claim 52] It is a liquid crystal display according to claim 51,
Said electrical installation part is a liquid crystal display formed in the periphery of said pixel electrode.
[Claim 53] It is a liquid crystal display according to claim 51,
A liquid crystal display equipped with a protection-from-light means to shade said a part of electrical installation part [at least].
[Claim 54] It is a liquid crystal display according to claim 14,
The liquid crystal display which is formed in the part of said slit, and is equipped with a projection higher than the front face of said pixel electrode, and this projection also commits as said 2nd domain regulation means.
[Claim 55] It is a liquid crystal display according to claim 1,
The projection of said 1st domain regulation means is the train of a projection of the shape of a straight line arranged in parallel in the predetermined pitch,
Said 2nd domain regulation means is the train of a projection or hollow of the shape of a straight line arranged in parallel in the predetermined pitch, or a slit,
Said predetermined pitch is a liquid crystal display smaller than the array pitch of a pixel.
[Claim 56] It is a liquid crystal display according to claim 1,
The projections of said 1st domain regulation means are two groups of the train of a projection of the shape of a straight line prolonged in the different direction arranged in parallel in the predetermined pitch,
Said 2nd domain regulation means is a projection or hollow of the shape of a straight line prolonged in the different direction arranged in parallel in the predetermined pitch, or two groups of the train of a slit,
Said predetermined pitch is a liquid crystal display smaller than the array pitch of a pixel.
[Claim 57] It is a liquid crystal display according to claim 56,
The direction where two groups are prolonged is a liquid crystal display different 90 degrees.
[Claim 58] It is a liquid crystal display according to claim 56,
When said 2nd domain regulation means is a projection or a slit The projection of said 1st domain regulation means of one group, the projection of said 2nd domain regulation means, or a slit It is the liquid crystal display sufficiently smaller than the condition that half-pitch gap ****** of said predetermined pitch is carried out, and the projection of said 1st domain regulation means of the group of another side, the projection of said 2nd structure, or a slit counters to said predetermined pitch by which amount gap ****** is carried out.
[Claim 59] It is a liquid crystal display given in any 1 term of claims 55-58,
Said predetermined pitch is a liquid crystal display which is 1 for an integer of the array pitch of said pixel.
[Claim 60] It is a liquid crystal display according to claim 1,
In the predetermined cycle, the projection of said 1st domain regulation means arranges in parallel two or more projections crooked in zigzag in a predetermined pitch, and is formed,
Said 2nd domain regulation means is a liquid crystal display which arranges in parallel two or more projections, hollows, or slits which were crooked in zigzag in a predetermined pitch, and is formed in the predetermined cycle.
[Claim 61] It is a liquid crystal display according to claim 60,
A pixel electrode has the configuration crooked in zigzag,
The projection of said 1st domain regulation means and the configuration of said 2nd domain regulation means are a liquid crystal display corresponding to the configuration of said pixel electrode.
[Claim 62] It is a liquid crystal display according to claim 61,
Some [at least] bus lines are liquid crystal displays which have the configuration crooked in the zigzag corresponding to the configuration of said pixel electrode.
[Claim 63] It is a liquid crystal display according to claim 60,

The display electrode of the train which a pixel electrode is a square mostly and adjoins is a liquid crystal display which the array pitch of this pixel electrode shifts 1/2, and is arranged.
[Claim 64] It is a liquid crystal display according to claim 63,
A data bus line is a liquid crystal display prolonged in zigzag along with the edge of a pixel electrode.
[Claim 65] It is a liquid crystal display according to claim 60,
Said predetermined pitch is a liquid crystal display which is 1 for an integer of the array pitch of said pixel.
[Claim 66] It is the liquid crystal display whose
 aforementioned predetermined cycle it is a liquid crystal display according to claim 65, and is 1 for an integer of the array pitch of said pixel.
[Claim 67] It is a liquid crystal display given in claims 55 and 56 or any 1 term of 60,
The projection of said 1st domain regulation means, the projection of said 2nd structure, or a slit is a liquid crystal display with which half-pitch gap ****** of said predetermined pitch is carried out when said 2nd domain regulation means is a projection or a slit.
[Claim 68] It is a liquid crystal display given in claims 55 and 56 or any 1 term of 60,
It is the liquid crystal display sufficiently smaller than the condition that the projection of said 1st structure, the projection of said 2nd structure, or a slit counters when said 2nd domain regulation means is a projection or a slit to said predetermined pitch by which amount gap ****** is carried out.
[Claim 69] It is a liquid crystal display given in claims 55 and 56 or any 1 term of 60,
The liquid crystal inlet for pouring in said liquid crystal between the substrates of said two upper and lower sides, when said 1st and 2nd domain regulation means are the trains of the projection arranged in parallel is a liquid crystal display arranged in the side of the liquid crystal display [perpendicular to the direction in which said projection is prolonged] concerned.
[Claim 70] It is a liquid crystal display according to claim 69,
The liquid crystal display with which the exhaust port which discharges a gas or said liquid crystal from between [of said two upper and lower sides] substrates when pouring in said liquid crystal between the substrates of said two upper and lower sides is arranged in the side of the opposite side of the side in which said liquid crystal inlet is established.
[Claim 71] It is a liquid crystal display according to claim 69,
The liquid crystal display with which the electrode which is not related to a display in order to impress an electrical potential difference to said liquid crystal is prepared in the part of said liquid crystal inlet.
[Claim 72] It is a liquid crystal display according to claim 10,
The projection of said 1st domain regulation means is a projection of the shape of a two-dimensional matrix (grid),
The projection of said 2nd structure is a liquid crystal display which is the punctiform projection arranged so that the core of the field surrounded by the projection of the two-dimensional shape of said matrix may be countered.
[Claim 73] It is a liquid crystal display according to claim 72,
The pitch of one [at least] direction of the projection of the two-dimensional shape of said matrix is a liquid crystal display smaller than the array pitch of a pixel.
[Claim 74] It is a liquid crystal display according to claim 72,
The pitch of a projection of the two-dimensional shape of said matrix is a liquid crystal display equal to the array of a pixel.
[Claim 75] It is a liquid crystal display according to claim 74,
It is the liquid crystal display formed by preparing the projection of the two-dimensional shape of said matrix in the boundary section of the pixel electrode of the TFT substrate with which an active element is formed so that said punctiform projection may counter on the color filter substrate which counters said TFT substrate at the core of said pixel electrode.
[Claim 76] It is a liquid crystal display according to claim 10,
The projection of said 1st and 2nd domain regulation means is a projection of the rectangle of the analog from which the neighboring die length changes in order,
The projection of the rectangle of said analog is a liquid crystal display arranged by turns so that the core of said rectangle may be in agreement.
[Claim 77] It is a liquid crystal display according to claim 76,
It is the liquid crystal display which said rectangles are a pixel and an analog, and is arranged by turns so that it

may be in agreement with the core whose core of said rectangle the die length of the side of the greatest rectangle is smaller than the array pitch of a pixel, and is a pixel.

[Claim 78] It is a liquid crystal display according to claim 1,

A liquid crystal display equipped with an auxiliary domain regulation means to give orientation restraining force in the direction which is different from the orientation regulation direction of said liquid crystal by the electric field produced outside said display pixel field when it is prepared in the edge of a display pixel field and an electrical potential difference is impressed.

[Claim 79] It is a liquid crystal display according to claim 78,

Said auxiliary domain regulation means is a liquid crystal display formed near [edge] said display pixel field along with this a part of edge.

[Claim 80] It is a liquid crystal display according to claim 10,

It is the liquid crystal display to which the projection nearest to a pixel electrode exists in said counterelectrode side by the inside of said pixel electrode, and the projection nearest to a pixel electrode exists in said pixel electrode side on the outside of said pixel electrode in the edge of each pixel electrode which extends in parallel to the longitudinal direction of the train of a projection of said 1st and 2nd domain regulation means.

[Claim 81] It is a liquid crystal display according to claim 80,

The projection nearest to a pixel electrode is a liquid crystal display arranged on the bus line in the outside of said pixel electrode.

[Claim 82] It is a liquid crystal display according to claim 10,

Said 1st and 2nd domain regulation means is the train of a projection,

At least one of the width of face of a projection part, spacing during an adjoining projection, and the height of a projection winds periodically on two or more conditions, and the train of this projection is a ************** liquid crystal display.

[Claim 83] It is a liquid crystal display according to claim 82,

For spacing during said adjoining projection, the direction near the bus line is a liquid crystal display narrower than the center section of the pixel.

[Claim 84] It is a liquid crystal display according to claim 82,

1 set of pixel groups consist of two or more pixels,

In two or more pixels of each pixel group, as for said projection, at least one of the width of face of a projection part, spacing during an adjoining projection, and the height of a projection differ,

Within each pixel, the width of face of a projection part, spacing during an adjoining projection, and the height of a projection are a fixed liquid crystal display.

[Claim 85] It is a liquid crystal display according to claim 84,

The liquid crystal display with which the thickness of the layer of said liquid crystal in two or more pixels differs.

[Claim 86] It is a liquid crystal display according to claim 10,

Said 1st and 2nd domain regulation means is the train of a projection,

the train of said projection -- the tilt angle (taper angle) of a side face -- the projection of two or more different values -- periodic -- winding -- ************** -- the liquid crystal display characterized by things.

[Claim 87] It is a liquid crystal display according to claim 86,

1 set of pixel groups consist of two or more pixels,

In two or more pixels of each pixel group, the tilt angles of the side face of said projection differ,

Within each pixel, the tilt angle of the side face of said projection is a fixed liquid crystal display.

[Claim 88] It is a liquid crystal display according to claim 1,

The liquid crystal display characterized by having a pixel electrode and the storage capacitance electrode which forms auxiliary capacity in accordance with said a part of 1st and 2nd domain regulation means.

[Claim 89] It is a liquid crystal display according to claim 1,

A liquid crystal display equipped with the protection-from-light pattern prepared in accordance with said 1st and 2nd domain regulation means.

[Claim 90] It is a liquid crystal display according to claim 1,

Said 1st domain regulation means is the train of a projection of the 1st of the shape of a straight line arranged in parallel in the 1st predetermined pitch,

Said 2nd domain regulation means is a liquid crystal display which is the train of a projection of the 2nd of the

shape of a straight line of a different direction from said 1st projection arranged in parallel in the 2nd predetermined pitch, or the train of the slit of an electrode.
[Claim 91] It is a liquid crystal display according to claim 90,
The liquid crystal display with which the projection or the slit is prepared in the core of the frame when seeing from a direction perpendicular to said substrate formed of the train of the train of one the projection of the 1st of said 1st substrate and said 2nd substrate of said, said 2nd projection, or a slit.
[Claim 92] It is a liquid crystal display according to claim 91,
The projection or slit projection prepared in the core of said frame is a liquid crystal display which has a configuration [**** / said frame] when it sees from a direction perpendicular to said substrate.
[Claim 93] It is a liquid crystal display according to claim 90,
The train of the train of said 1st projection, said 2nd projection, or a slit is a liquid crystal display which lies at right angles.
[Claim 94] It is a liquid crystal display according to claim 90,
It is the liquid crystal display on which said 2nd domain regulation means is the train of the 2nd projection, the thickness for an intersection of the train of said 1st projection and the train of said 2nd projection is equal to the thickness of the layer of said liquid crystal, and the amount of this intersection functions as a spacer.
[Claim 95] It is a liquid crystal display according to claim 1,
Said 1st domain regulation means is the projection of the 1st of the two-dimensional shape of a matrix of a predetermined array pitch,
Said 2nd domain regulation means is the projection of the 2nd of the two-dimensional shape of a matrix of the same array pitch as said 1st projection, or the slit of an electrode,
Said the 1st projection, said 2nd projection, or slit is a liquid crystal display with which half-pitch gap ****** of said array pitch is carried out in the two array directions of said matrix, respectively.
[Claim 96] It is a liquid crystal display according to claim 95,
Said the 1st projection, said 2nd projection, or slit is a liquid crystal display which the part which said the 1st projection, said 2nd projection, or slit intersects is removed by turns, and is intermittent when it sees from a direction perpendicular to a matrix.
[Claim 97] It is a liquid crystal display according to claim 10,
The liquid crystal display with which some electrodes of said the 1st and 2nd substrate are formed only in one side of the slant face of said projection.
[Claim 98] It is a liquid crystal display according to claim 97,
The projection of said 1st and 2nd domain regulation means is a liquid crystal display which penetrates the light.
[Claim 99] It is a liquid crystal display according to claim 97,
The liquid crystal display with which the slant face in which said electrode of a projection of said 1st and 2nd domain regulation means is not formed is arranged by approaching.
[Claim 100] It is a liquid crystal display according to claim 1,
One color filter substrate of said two substrates,
Transparence base material,
Two or more kinds of color separation filters formed in this transparence base material for every field,
The transparent electrode formed on this color separation filter,
A liquid crystal display equipped with the light-shielding film formed in the position on this transparent electrode.
[Claim 101] It is a liquid crystal display according to claim 1,
The liquid crystal display whose mole ratio of the PORIU ethane resin to said liquid crystal and this liquid crystal and the amount of mixing of the skin is 1/1000 or less.
[Claim 102] It is a liquid crystal display according to claim 101,
Said polyurethane resin and skin which were mixed to said liquid crystal are a liquid crystal display which is less than [area 5micrometerx5micrometer], and is height of 3 micrometers or less.
[Claim 103] It is the manufacture approach of the substrate for perpendicular orientation liquid crystal displays of having the projection which works as a domain regulation means to regulate so that the direction where the orientation of said liquid crystal becomes slanting when an electrical potential difference smaller than a predetermined electrical potential difference is impressed may come in two or more directions in each pixel on

a front face,
After forming an electrode in the front face of the substrate concerned,
The process which forms a projection,
The process which performs surface treatment for making formation of the perpendicular orientation film easy to the front face of this projection,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays characterized by having the process which forms the perpendicular orientation film in the front face of said substrate including said projection to which said electrode and surface treatment were performed.
[Claim 104] It is the manufacture approach according to claim 103,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays that irregularity is formed in the front face of said projection of plasma ashing processing at the process which performs surface treatment to the front face of said projection.
[Claim 105] It is the manufacture approach according to claim 103,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays that irregularity is formed in the front face of said projection of ozone ashing processing at the process which performs surface treatment to the front face of said projection.
[Claim 106] It is the manufacture approach according to claim 103,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays that irregularity is formed in the front face of said projection of brush washing at the process which performs surface preparation to the front face of said projection.
[Claim 107] It is the manufacture approach according to claim 103,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays that irregularity is formed in the front face of said projection of rubbing processing at the process which performs surface preparation to the front face of said projection.
[Claim 108] It is the manufacture approach according to claim 103,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays that ultraviolet rays are irradiated by said projection at the process which performs surface treatment to the front face of said projection.
[Claim 109] It is the manufacture approach according to claim 103,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays which applies a silane system coupling agent to the substrate with which said projection was formed in the front face of said projection at the process which performs surface treatment.
[Claim 110] It is the manufacture approach according to claim 103,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays of making said projection foaming on the front face of said projection at the process which performs surface treatment.
[Claim 111] It is the manufacture approach according to claim 110,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays to which said projection is made to foam by carrying out sudden heating of the substrate with which said projection was formed in the front face of said projection at the process which performs surface treatment.
[Claim 112] It is the manufacture approach of the substrate for perpendicular orientation liquid crystal displays of having the projection which works as a domain regulation means to regulate so that the direction where the orientation of said liquid crystal becomes slanting when an electrical potential difference smaller than a predetermined electrical potential difference is impressed may come in two or more directions in each pixel on a front face,
After forming an electrode in the front face of the substrate concerned,
The process which applies the molding resin which forms a projection,
The process which sprinkles a particle on the front face of said molding resin,
The process which fabricates said molding resin to a projection,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays characterized by having the process which forms the perpendicular orientation film in the front face of said substrate including said electrode and said projection.
[Claim 113] It is the manufacture approach of the substrate for perpendicular orientation liquid crystal displays of having the bank committed as a domain regulation means to regulate so that the direction where the

orientation of said liquid crystal becomes slanting when an electrical potential difference smaller than a predetermined electrical potential difference is impressed may come in two or more directions in each pixel on a front face,
After forming an electrode in the front face of the substrate concerned,
The process which approaches and forms two banks by the photosensitive resist,
The process made into the bank where it heated, said two banks were united, and the center became depressed,
The manufacture approach of the substrate for perpendicular orientation liquid crystal displays characterized by having the process which forms the perpendicular orientation film in the front face of said substrate including said electrode and said projection.
[Claim 114] A dielectric constant anisotropy pinches negative liquid crystal between the substrates of two upper and lower sides which performed perpendicular orientation processing to the substrate front face. The orientation of said liquid crystal becomes almost level, when a predetermined electrical potential difference is impressed almost perpendicularly at the time of no electrical-potential-difference impressing. It is the manufacture approach of the color filter substrate which was used for the liquid crystal display which becomes slanting as one side of said two substrates when an electrical potential difference smaller than said predetermined electrical potential difference was impressed, and formed two or more kinds of color separation filters in the transparence base material for every field,
Said process which carries out pattern NINGU of the two or more color separation filters in the color separation filter of a class one by one, and forms them in piles in a predetermined part, [two or more]
The process which applies a positive type photopolymer,
The manufacture approach of the color filter substrate characterized by having the process which forms a projection by developing said positive type photopolymer after exposing the beam of light which is wavelength with the transmission of the part which piled up said two or more color separation filters smaller enough than the transmission of the other part, and said positive type photopolymer exposes to said positive type photopolymer through said coloring member.
[Claim 115] It is the manufacture approach of a color filter substrate according to claim 114,
The manufacture approach of the color filter substrate equipped with the process which forms a transparent flattening layer after [said] forming two or more color separation filters of a class.
[Claim 116] It is the manufacture approach of a color filter substrate according to claim 115,
Said positive type photosensitivity resist is the manufacture approach of a color filter substrate of having protection-from-light nature.
[Claim 117] A dielectric constant anisotropy pinches negative liquid crystal between the substrates of two upper and lower sides which performed perpendicular orientation processing to the substrate front face. The orientation of said liquid crystal becomes almost level, when a predetermined electrical potential difference is impressed almost perpendicularly at the time of no electrical-potential-difference impressing. It is the manufacture approach of the color filter substrate which was used for the liquid crystal display which becomes slanting as one side of said two substrates when an electrical potential difference smaller than said predetermined electrical potential difference was impressed, and formed two or more kinds of color separation filters in the transparence base material for every field,
The process which forms two or more kinds of color separation filters for every field on a transparence base material,
The process which forms a transparent electrode on said color separation filter,
The process which forms a light-shielding film in the position on said transparent electrode,
The manufacture approach of the color filter substrate characterized by having the process which forms an insulating projection in the position on said light-shielding film.
[Claim 118] It is the manufacture approach of a color filter substrate according to claim 117,
At the process which forms said light-shielding film
The process which applies a photosensitive resist on this light-shielding film containing said transparent electrode,
The process etched after exposing and developing this photosensitive resist according to a predetermined pattern,
It has the process which anneals said photosensitive resist left behind on said light-shielding film after etching,
Said photosensitive resist left behind on said light-shielding film is the manufacture approach of the color filter

substrate which works as said insulating projection.
[Claim 119] It is the manufacture approach of a color filter substrate according to claim 117,
After the process which forms said light-shielding film,
The process which applies a positive type photopolymer on said transparent electrode containing this light-shielding film,
The process which develops said positive type photopolymer after exposing this positive type photopolymer through said light-shielding film,
It has the process which anneals said photopolymer left behind on said light-shielding film after development,
Said photopolymer left behind on said light-shielding film is the manufacture approach of the color filter substrate which works as said insulating projection.
[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the technique in which the VA (Vertically Aligned) mold LCD (VA mode LCD) realizes orientation division, about a liquid crystal display (LCD:Liquid Crystal Display).
[0002]
[Description of the Prior Art] In the flat-panel display which is equal to the image quality of CRT, the liquid crystal display (LCD) is used current but widely. Especially as for LCD (TFT-LCD) of a TFT (ThinFilm Transistor) method, much more expansion of a commercial scene is expected by application to household-electric-appliances devices, such as consumer appliances, such as a personal computer, a word processor, and OA equipment, and pocket television. In connection with this, much more improvement in image quality is demanded. Hereafter, although TFT-LCD is explained as an example, this invention can be applied not only to TFT-LCD but to LCD of a passive-matrix mold and LCD of a plasma address type, and liquid crystal is pinched between the substrates of a pair with which the electrode was generally formed in each, and application to LCD which displays by impressing an electrical potential difference to inter-electrode [of each substrate] is possible, and it is not limited to TFT-LCD.
[0003] The method currently used most widely at current and TFT-LCD is TN (Twisted Nematic) of a normally white mode. It is Mold LCD. Drawing 1 is drawing explaining the panel structure and the principle of operation of the TN mold LCD. As shown in drawing 1, the orientation film is attached on the transparent electrodes 12 and 13 formed on the glass substrate, rubbing processing from which the 90 degrees of the directions of orientation of a liquid crystal molecule differ with a vertical substrate is performed, and TN liquid crystal is inserted. In order that other liquid crystal molecules may carry out orientation of the liquid crystal which contacted the orientation film from the property which liquid crystal has along with a list and its liquid crystal molecule along the direction of orientation of the orientation film, as shown in (1) of drawing 1, orientation of it is carried out in the form where the 90 degrees of the directions of a liquid crystal molecule are twisted. Two polarizing plates 11 and 15 are arranged to the direction of orientation of the orientation film, and parallel at the both sides of electrodes 12 and 13.
[0004] If the non-polarized light 10 carries out incidence to the panel of such structure, the light which passed the polarizing plate 11 will turn into the linearly polarized light, and will go into liquid crystal. 90 degrees of liquid crystal molecules are twisted, and since orientation is carried out, 90 degrees also of light which carried out incidence are also twisted and they is passed, the lower polarizing plate 15 can be passed. This condition is bright state. Next, if an electrical potential difference is impressed to electrodes 12 and 13 and an electrical potential difference is impressed to a liquid crystal molecule as shown in (2) of drawing 1, a liquid crystal molecule is stood straight and ** can be taken. However, on the orientation film front face, since the orientation restraining force is stronger, the direction of orientation of a liquid crystal molecule has met the orientation film. In such the condition, to the light which passes a liquid crystal molecule, since it is isotropic, the rotation of the polarization direction of the linearly polarized light by which incidence was carried out to the liquid crystal layer is not produced. Therefore, the linearly polarized light which passed the upper polarizing plate 11 cannot pass the lower polarizing plate 15, but will be in a dark condition. Then, if it changes into the condition of not impressing an electrical potential difference again, a display will return to bright state according to orientation restraining force.
[0005] The manufacturing technology of TN mold TFT-LCD accomplished the marked advance in recent years, and by the time the contrast, color reproduction nature, etc. in a transverse plane exceed CRT, it will have

resulted. However, TN-LCD had the big fault that an angle of visibility was narrow, therefore there was a problem that an application was limited. Drawing 2 is drawing explaining this problem, is in the condition of a white display that (1) does not impress an electrical potential difference, is in the condition which displays the halftone to which (2) impressed the middle electrical potential difference, and is in the condition which displays the black to which (3) impressed the predetermined electrical potential difference. As shown in (1) of drawing 2, in the condition of not impressing an electrical potential difference, orientation of the liquid crystal molecule is carried out in the same direction with very few tilt angles (1 degree - about 5 degrees). Although it was twisted as shown in (1) of drawing 1 in fact, here showed like illustration for convenience. In this condition, it is mostly visible to white in every bearing. Moreover, as shown in (3) of drawing 2, where an electrical potential difference is impressed, since orientation of the liquid crystal molecule in the middle of having removed near the orientation film is carried out perpendicularly, the linearly polarized light which carried out incidence is not twisted, but it is visible [linearly polarized light] to black. At this time, the polarization direction is twisted to some extent and the light which carries out incidence aslant on a screen has it in order to pass aslant the liquid crystal molecule by which orientation was carried out perpendicularly. [visible to the halftone (gray) instead of perfect black] Although orientation of the liquid crystal molecule near the orientation film is too carried out horizontally where a middle electrical potential difference lower than the condition of (3) is impressed as shown in (2) of drawing 2, in the pars intermedia of a cel, a liquid crystal molecule starts to the middle. Therefore, the form birefringence of liquid crystal is lost a little, permeability falls, and it becomes a halftone (gray) display. However, this is what can be said only about the light which carried out incidence perpendicularly to the liquid crystal panel, and situations differ by the case where it sees from the left of the light which carried out incidence aslant, i.e., drawing, and the direction of the right. Like illustration, orientation of the liquid crystal molecule will be carried out from the lower right in parallel to the light which goes to the upper left. Therefore, when liquid crystal is seen from left-hand side in order to hardly demonstrate the birefringence effectiveness, it will look black. On the other hand, since orientation of the liquid crystal molecule is perpendicularly carried out from the lower left to the light which goes to the upper right, liquid crystal demonstrates the big birefringence effectiveness to the light which carried out incidence, and since the light which carried out incidence is twisted, it becomes the display near white. Thus, the point which viewing-angle dependence produces in the display condition is the greatest fault of TN-LCD.

[0006] In order to solve such a problem, LCD of the method called an IPS mold is proposed by JP,53-48452,B and JP,1-120528,B. (2) is a plan when not impressing an electrical potential difference, drawing 3 is drawing explaining the IPS mold LCD, and (4) is [(1) is a side elevation when not impressing an electrical potential difference, and / (3) is a side elevation when impressing an electrical potential difference, and] a plan when impressing an electrical potential difference. The slit-like electrodes 18 and 19 are formed in one substrate 17, and the liquid crystal molecule of the slit inter-electrode gap section is made to drive by horizontal electric field in an IPS mold, as shown in drawing 3. when not impressing electric field using the ingredient which has a forward dielectric anisotropy as liquid crystal 14, rubbing of the orientation film is carried out for carrying out homogeneous orientation of the major axis of a liquid crystal molecule almost in parallel to the longitudinal direction of electrodes 18 and 19. In the example shown here, in order to set constant the change direction (hand of cut) of the direction of orientation of the liquid crystal molecule at the time of electrical-potential-difference impression, homogeneous orientation of the liquid crystal molecule is carried out to 15-degree bearing to the longitudinal direction of a slit electrode. If an electrical potential difference is impressed to slit inter-electrode in this condition, as shown in (3) of drawing 3, near a slit electrode, the liquid crystal molecule which has a dielectric anisotropy will change the direction of orientation so that that major axis may become 90 degrees to the longitudinal direction of a slit electrode. However, since orientation processing is carried out so that orientation of the liquid crystal molecule may be carried out to the substrate 16 of another side in the 15-degree bearing to the longitudinal direction of a slit electrode, orientation of the major axis is carried out almost in parallel to the longitudinal direction of electrodes 18 and 19, a liquid crystal molecule will be twisted toward the lower substrate 17 from the upper substrate 16, and orientation of the liquid crystal molecule near the substrate 16 will be carried out. In such a liquid crystal display, by [of substrates 16 and 17] making a transparency shaft intersect perpendicularly mutually up and down, arranging, and making the transparency shaft of one polarizing plate parallel to a liquid crystal molecule major axis, polarizing plates 11 and 15 can be realized at the time of no electrical-potential-difference impressing, and a white display can be realized at the time of a black display and electrical-potential-difference impression.

[0007] As mentioned above, by the IPS method, a liquid crystal molecule is not made to start but the description is that it switches to a longitudinal direction. Like TN method, if a liquid crystal molecule is made to stand, according to the viewing-angle direction, form birefringence will differ and fault will arise. If it switches to a longitudinal direction, since form birefringence seldom changes, a very good viewing-angle property will be acquired by the direction. However, another trouble exists in an IPS method. First, it is the point that a speed of response is very slow. An IPS method is considered because it is 10 micrometers or more to the usual TN method having switched the reason nil why a speed of response is slow, by inter-electrode gap 5micrometer. If inter-electrode spare time is narrowed, a speed of response can be made high, but since short-circuit will be caused and it will be easy to become a display defect if it is necessary to add the electric field of reversed polarity to the electrode which adjoins on a method and inter-electrode spare time is made small, inter-electrode spare time cannot be made not much small. Moreover, if inter-electrode spare time is made small, the rate of surface ratio which the electrode section in a part for a display occupies will become large, and the problem that permeability cannot be made high will also be produced.
[0008] Thus, by the IPS method, if switching is slow and displays the quick animation of a motion in the present condition, fault, like an image flows will occur. Therefore, by the actual panel, in order to improve a speed of response, as shown in (2) of drawing 3, and (4), rubbing is not carried out in parallel to an electrode, but rubbing is carried out in the direction shifted about 15 degrees. When carrying out parallel orientation, it can arrange in the direction which the molecule of liquid crystal can influence freely, and the orientation of the liquid crystal molecule cannot be made to carry out in the predetermined direction only by applying the orientation film. Then, the front face of the orientation film is ground in the fixed direction so that orientation may be carried out in the predetermined direction, and rubbing processing which makes a liquid crystal molecule arrange in the direction is performed. If rubbing processing is carried out in parallel with an electrode when an IPS method performs rubbing processing, the direction rotated when an electrical potential difference is impressed cannot become settled easily in the left or the right, and the liquid crystal molecule near an inter-electrode center will be in a response. Then, as shown in (2) of drawing 3, and (4), uniformity on either side is broken down by shifting about 15 degrees and performing rubbing processing. However, even if it shifts the direction of rubbing processing in this way, the speed of response of an IPS method is twice the response time of TN method, and has the problem of being very late. And it does not become equal by shifting about 15 degrees in this way, and performing rubbing processing influencing a viewing-angle property. Moreover, in an IPS method, tone reversal occurs in a specific angle of visibility. This problem is explained with reference to drawing 6 from drawing 4.
[0009] Drawing 4 is drawing which defines the system of coordinates in observation of a liquid crystal display (here IPS method). Like illustration, the polar angle theta and Azimuth phi are defined to substrates 16 and 17, electrodes 18 and 19, and the liquid crystal molecule 14. It is drawing showing the tone reversal property of a panel, drawing 5 displays by dividing from confession voice to a black condition into 8 gradation, and when the polar angle theta and Azimuth phi are changed and brightness change is investigated, it shows the field which tone reversal produces. Reversal arises among drawing into four parts shown with a slash and a cross slash. Drawing 6 is drawing showing an example of brightness change of 8 gradation displays to the polar angle theta in bearing (phi= 75 degrees, 135 degrees) which white reversal and black reversal produce, respectively. White reversal is produced when falling with the increment in the polar angle theta, the gradation phase, i.e., the white brightness, of a side with high brightness. Black reversal is produced because black brightness rises according to the increment in the polar angle theta. Thus, by the IPS method, the problem that tone reversal arises about 4 bearing occurs. Furthermore, an IPS method has the problem that manufacture is difficult compared with TN method. Thus, it can be said that other properties, such as permeability, a speed of response, and productivity, are sacrificed for the IPS method in exchange for a viewing-angle property.
[0010] As explained above, the IPS method proposed as what solves the problem of the viewing-angle property of TN method had the problem that it was not enough in respect of properties other than a viewing-angle property. Then, VA (Vertically aligned) method (VA mode liquid crystal) which uses the perpendicular orientation film is proposed. By VA method, it becomes the birefringence mode instead of rotatory-polarization mode like TN method. Drawing 7 is drawing explaining VA method. VA method is a method which combined the negative-mold liquid crystal ingredient and the vertical orientation film which have a negative dielectric constant anisotropy, and as shown in (1) of drawing 7, at the time of no electrical-potential-difference impressing, orientation of the liquid crystal molecule is carried out perpendicularly, and it becomes a black

display. If a predetermined electrical potential difference is impressed as shown in (3) of drawing 7, orientation of the liquid crystal molecule will be carried out horizontally, and it will become a white display. Compared with TN method, VA method has the high contrast of a display and its monochrome level speed of response is also quick. VA method attracts attention as a method of a new liquid crystal display by the above reasons.
[0011]
[Problem(s) to be Solved by the Invention] However, when VA method performs a halftone display, there is the same problem as TN method that viewing-angle dependence of a display condition arises. Although it impresses an electrical potential difference smaller than the time of a white display in displaying halftone by VA method, as shown in (2) of drawing 7 in that case, orientation of the liquid crystal molecule will be carried out in the direction of slanting. In this case, to the light which goes to the upper left, orientation of the liquid crystal molecule will be carried out in parallel like illustration from the lower right. Therefore, when liquid crystal is seen from left-hand side in order to hardly demonstrate the birefringence effectiveness, it will look black. On the other hand, since orientation of the liquid crystal molecule is perpendicularly carried out from the lower left to the light which goes to the upper right, liquid crystal demonstrates the big birefringence effectiveness to the light which carried out incidence, and becomes the display near white. Thus, there was a problem that viewing-angle dependence of a display condition arose. since the liquid crystal molecule near the orientation film was almost perpendicular also at the time of no electrical-potential-difference impressing, VA method was boiled markedly, and its contrast was higher than TN method, and it was excellent also in the viewing-angle property, but also when inferior to an IPS method in respect of calling it a viewing-angle property, there was.
[0012] It is known by setting to TN method and making the direction of orientation of the liquid crystal molecule in a pixel into two or more different directions that the viewing-angle property of a liquid crystal display (LCD) will be improved. Generally with TN method, the direction of orientation of the liquid crystal molecule which touches a substrate side (pre tilt angle) is regulated in the direction of the rubbing processing performed to the orientation film. Rubbing processing is processing which grinds the front face of the orientation film against an one direction with cloth, such as rayon, and orientation of the liquid crystal molecule is carried out along the direction of the remains of grinding. Therefore, if the direction of rubbing processing is changed within a pixel, a viewing-angle property is improvable. Drawing 8 is drawing showing how to change the direction of rubbing processing within a pixel. The orientation film 22 is formed in a glass substrate 16 (the electrode etc. is omitted.) like illustration. The rubbing roll 201 to rotate is contacted to this, and rubbing processing is performed to it in an one direction. Next, a resist is applied on the orientation film 22, and a pattern predetermined by the photolithography is exposed and developed. Thereby, the layer 202 of a patternized resist like illustration is formed. Next, the rubbing roll 201 rotated in the direction contrary to the above is contacted, and rubbing processing only of the part which the pattern opened is carried out to hard flow. Thus, two or more fields by which rubbing processing was carried out are formed in the different direction in a pixel, and the direction of orientation of liquid crystal becomes in two or more directions within a pixel. In addition, if the orientation film 22 is rotated to a rubbing roll 201, it is possible to carry out rubbing processing in the direction in which arbitration differs.
[0013] Although rubbing processing is used widely, it is the processing which grinds the front face of the orientation film as mentioned above, and attaches a blemish, and there is a problem of being easy to generate dust. Moreover, preparing a concavo-convex pattern on an electrode is known for TN method as an option which regulates the pre tilt angle of a liquid crystal molecule. Orientation of the liquid crystal molecule near the electrode is carried out along the front face of a concavo-convex pattern.
[0014] Also in VA method, it is known by dividing the direction of orientation of a liquid crystal molecule in the direction from which plurality differs within a pixel that a viewing-angle property will be improved. By preparing opening in the part which faces in the center of the pixel electrode of a counterelectrode each other, JP,6-301036,A makes a pixel center section produce the part toward which electric field inclined, and is indicating the liquid crystal display of VA method which divides the direction of orientation of a liquid crystal molecule in a 2-way or the four directions. However, in the liquid crystal display indicated by JP,6-301036,A, there is a problem that a speed of response is slow, and it turned out that the speed of response when changing to the condition of impressing from the condition of not impressing especially the electrical potential difference is slow. Since the die length of the field where the direction of orientation formed in a pixel continued is one half extent of the die length of a pixel, this is considered for requiring time amount until the orientation of all

the liquid crystal in a field gathers.
[0015] Moreover, JP,7-199193,A is indicating the liquid crystal display of VA method which divides the direction of orientation of liquid crystal into two or more fields within a pixel by preparing on an electrode the inclined plane where directions differ. However, with the indicated configuration, since orientation of the liquid crystal which contacts an orientation side when not impressing an electrical potential difference since the inclined plane is established in the whole pixel was altogether carried out along an inclined plane, it could not obtain a perfect black display but the problem that contrast fell produced it. Moreover, since the inclined plane was established in the whole pixel, it turned out that an inclined plane cannot say that it is loose and enough to specify the direction of orientation of liquid crystal. Although the structure needed to be thickened for making an inclined plane steep, it turned out that the phenomenon called so-called printing in which the direction of a liquid crystal molecule does not change even if a charge will be accumulated in the structure working [equipment] and it will impress an electrical potential difference to inter-electrode for the accumulated charge, if the structure of a dielectric is thickened arises.
[0016] Thus, in the liquid crystal display of VA method, when orientation division within the pixel for improving a viewing-angle property was realized, there were various kinds of problems. The purpose of this invention is improving the viewing-angle property in the liquid crystal display of VA method, as usual, while they have been good, the viewing-angle property of contrast and a working speed is also comparable as an IPS method, or they aim it at realizing the liquid crystal display of better VA method than it.
[0017]
[Means for Solving the Problem] Drawing 9 is drawing explaining the principle of this invention. According to this invention, as shown in drawing 9, the conventional perpendicular orientation film is used, and when an electrical potential difference is impressed, in VA method which enclosed negative-mold liquid crystal as a liquid crystal ingredient, a domain regulation means to regulate so that the direction of orientation where orientation of the liquid crystal is carried out aslant may come in two or more directions in 1 pixel is established. A domain regulation means is formed at least in one side of two substrates. Moreover, as what functions as a domain regulation means, as for at least one domain regulation means, various **** have a slant face. In addition, the field where a cross section starts to an abbreviation perpendicular to a substrate in a rectangle shall also be included on a slant face. In drawing 9, the electrode 12 of a top substrate was used as the electrode which has a slit within 1 pixel as a domain regulation means, and the projection 20 is formed on the electrode 13 of a bottom substrate.
[0018] As shown in (1) of drawing 9, in the condition of not impressing an electrical potential difference, orientation of the liquid crystal molecule is perpendicularly carried out to a substrate front face. Impression of a middle electrical potential difference generates slanting electric field to a substrate front face in the electrode slit section (electrode edge section), as shown in (2) of drawing 9. Moreover, the liquid crystal molecule of a height 20 inclines slightly from electrical-potential-difference the condition of not impressing. The inclination direction of a liquid crystal molecule is determined under the inclined plane of this projection, and the effect of slanting electric field, and the direction of orientation of liquid crystal is divided in the middle of projection 20 and a slit. Since the liquid crystal molecule inclines somewhat, as for at this time, for example, the light penetrated right above from right under, it is influenced of some birefringence, and transparency is suppressed, and a gray halftone display is obtained. If it is very easy to penetrate the light penetrated at the upper left from the lower right in the field which is hard to penetrate in the field in which liquid crystal inclined leftward and which inclined rightward and it is averaged, a gray halftone display will be obtained. The light penetrated at the upper right also serves as a gray display from the lower left by the same principle, and a uniform display is obtained in an omnidirection. Furthermore, if a predetermined electrical potential difference is impressed, a liquid crystal molecule will become almost level and a white display will be obtained. Therefore, in all the conditions of black, halftone, and a white display condition, little good display of a viewing-angle dependency is obtained.
[0019] Here, drawing 10 is drawing explaining generation of the orientation by the projection of the dielectric prepared on the electrode. In addition, the "dielectric" in this specification is the insulating material of a low dielectric. The orientation by projection is considered referring to drawing 10. On electrodes 12 and 13, the projection is formed alternately, and the perpendicular orientation film 22 is formed on it. Since the liquid crystal currently used is a negative mold, as it is shown in (1) of drawing 10, at the time of no electrical-potential-difference impressing, orientation of the liquid crystal molecule is perpendicularly carried out to a

substrate front face for the perpendicular orientation film 22. In this case, it is not necessary to perform rubbing processing to the perpendicular orientation film. Since it is going to carry out orientation also of the liquid crystal molecule of the part of projection 20 at right angles to the slant face, the liquid crystal molecule of the part of a projection inclines. However, at the time of no electrical-potential-difference impressing, in almost all the parts except the part of a projection, in order to carry out orientation of the liquid crystal molecule almost perpendicularly to a substrate front face, as shown in (1) of drawing 9, a good black display is obtained.
[0020] In the part which shows potential distribution, such as having met the electrode surface in a liquid crystal layer, to (2) of drawing 10, and (a), and does not have a projection at the time of electrical-potential-difference impression, in a substrate, although it is parallel (electric field are perpendicular to a substrate), it inclines near the projection. If an electrical potential difference is impressed, as shown in (2) of drawing 7, a liquid crystal molecule inclines according to the reinforcement of electric field, but since electric field are sense perpendicular to a substrate, when rubbing has not prescribed the inclination direction, bearing which inclines to electric field may have all 360-degree directions. Here, if there is a liquid crystal molecule which inclines beforehand as shown in (1) of drawing 10, since the liquid crystal molecule of the perimeter also inclines along the direction, even if it does not perform rubbing processing, it can specify to the direction toward which the liquid crystal molecule of the projection gap section inclines in the bearing of the liquid crystal molecule which touches on the surface of a projection. it is in agreement with the direction where this direction inclines from the first for a projection although it will incline in the direction where a negative-mold liquid-crystal molecule is perpendicular to electric field if it leans in the direction which becomes parallel to the slant face of a projection in the part of a projection as for electric field as shown in (2) of drawing 10 (namely, the direction which becomes perpendicular [the equipotential line] to a slant face -- it is) and an electrical potential difference is impressed, and orientation will be carried out in the stable direction more. Thus, formation of a projection obtains the orientation stabilized according to the effectiveness of both electric fields across near [the / an inclination and near the projection]. Furthermore, if a strong electrical potential difference is impressed, a liquid crystal molecule will become almost parallel to a substrate.
[0021] As mentioned above, the projection has played the role of the trigger which determines bearing as for which the liquid crystal molecule when impressing an electrical potential difference carries out orientation, and the slant face of a big area, for example, a thing across which it goes all over a pixel, is unnecessary. However, even if too small, the effectiveness of an inclination and electric field is no longer acquired. Therefore, although it is necessary to define width of face according to an ingredient and a configuration, effectiveness sufficient by 5-micrometer width of face is acquired, and it is thought that about 5 micrometers or more are required also at the lowest. Since a steep slant face can be formed even if it makes the height (thickness) of a projection small if it is a small slant face, the direction of orientation of liquid crystal is fully controllable. Moreover, if it is a small slant face, since orientation of the liquid crystal molecule will be perpendicularly carried out to the substrate front face in almost all the parts except the part of a projection at the time of no electrical-potential-difference impressing and it will become a nearly perfect black display, contrast can be made high. Furthermore, since the slant face is used as a domain regulation means and the liquid crystal of other parts changes a direction immediately by making liquid crystal of this part into a trigger when the liquid crystal which touches a domain regulation means has turned to the predetermined direction beforehand even when not impressing an electrical potential difference, and an electrical potential difference is impressed, a working speed is also good.
[0022] The direction where the orientation of liquid crystal becomes slanting is determined by the domain regulation means. Drawing 11 is drawing showing the direction of orientation at the time of using a projection as a domain regulation means. (1) of drawing 11 is a bank which has two slant faces, and orientation is carried out in the two directions which are different 180 degrees bordering on a bank. (2) of drawing 11 is a square drill, and orientation is carried out in the four directions which differ at a time 90 **s bordering on the top-most vertices of a square drill. (3) of drawing 11 is a semi-sphere, and the orientation of liquid crystal becomes the symmetry of revolution centering on the shaft of a semi-sphere perpendicular to a substrate. If it is (3) of drawing 11, it will be in the same display condition to a total viewing angle. However, the number and sense of a domain are not that it is better as many. In relation with the polarization direction of a polarizing plate, when the orientation of slanting liquid crystal becomes the symmetry of revolution, the problem that the use effectiveness of light is low arises. When, as for this, liquid crystal forms a domain in a radial at a stepless story, the transparency shaft of a polarizing plate and the liquid crystal of absorption shaft orientation serve as a loss, and the liquid crystal of the direction of 45 degree is because it is the most efficient to a shaft. In order to raise

the use effectiveness of light, the directions where the orientation of liquid crystal becomes slanting are mainly four or less directions, and, in the case of four directions, it is desirable to make it become in the direction in which 90 degrees of projection components to the screen of a liquid crystal display differ at a time.
[0023] Although the electrode 12 of a top substrate was used as the electrode which has a slit within 1 pixel as a domain regulation means and the projection 20 is formed on the electrode 13 of a bottom substrate in drawing 9, it is realizable with other means. Drawing 12 is drawing showing the example which realizes a domain regulation means, (1) shows the example realized only in an electrode configuration, (2) shows the example which devises the configuration on the front face of a substrate, and (3) shows the example which devises an electrode configuration and the configuration on the front face of a substrate. Although the orientation shown in drawing 9 by all of this example is obtained, structures [each] differ somewhat.
[0024] In (1) of drawing 12, a slit is prepared in the ITO electrodes 12 and 13 of the substrate of both sides or one side. Perpendicular orientation processing is performed to a substrate front face, and negative-mold liquid crystal is enclosed. In the condition of not impressing an electrical potential difference, although orientation of the liquid crystal molecule is perpendicularly carried out to a substrate front face, if an electrical potential difference is impressed, the electric field of the direction of slanting will occur to a substrate front face in the electrode slit section (electrode edge section). The inclination direction of a liquid crystal molecule is determined under the effect of the electric field of this slant, and the direction of orientation of liquid crystal is divided into a longitudinal direction like illustration. Since orientation of the liquid crystal is carried out to a longitudinal direction by the electric field of the slant produced in the edge section of an electrode in this example, suppose that it is called a slanting electric-field method. However, since slanting electric field do not arise as mentioned above when not impressing an electrical potential difference to inter-electrode, the direction of liquid crystal is not specified, but this method has the problem that the speed of response when changing from electrical-potential-difference the condition of not impressing to an electrical-potential-difference impression condition is low.
[0025] In (2) of drawing 12, projection 20 is formed on the substrate of both sides. Like the case of (1), perpendicular orientation processing is performed to a substrate front face, and negative-mold liquid crystal is enclosed. Although orientation of the liquid crystal molecule is fundamentally carried out perpendicularly to a substrate front face in the condition of not impressing an electrical potential difference, on the inclined plane of a projection, orientation is carried out with some inclination. If an electrical potential difference is impressed, orientation of the liquid crystal molecule will be carried out in the inclination direction. Moreover, if an insulating material is used for a projection, electric field will be intercepted (the condition near slanting electric field and a method: it is the same as having prepared the slit in the electrode), and still more stable orientation division will be obtained. Suppose that this method is called a double-sided projection method.
[0026] (3) of drawing 12 is the example which combined the method of (1) and (2), and it omits explanation. Various modifications are possible although the example of a projection and a slit was shown as a domain regulation means above. For example, it is also possible to hollow the slit section and to make the part into an inclined plane by (1) of drawing 12. Making it the electrode which has a projection can also regulate orientation by preparing a projection on a substrate and forming an ITO electrode after a substrate and a projection instead of making a projection from (2) of drawing 12 with an insulating ingredient. Moreover, considering as a hollow instead of a projection is also possible. Furthermore, it is also possible to form the explained domain regulation means only in the substrate of one side, and when preparing in both substrates, it is also possible to use which combination. Moreover, although it is desirable to make it have an inclined plane as for a projection or a hollow, it is effective also in respect of being perpendicular.
[0027] In a projection, if it indicates by black, as for the projection gap section, also in a black display, in a projection part, light will leak strictly. Although the difference of such a partial display is microscopic and it cannot distinguish with the naked eye, the whole display will be those averages, and the display concentration of a black display falls a little, and reduces contrast. Therefore, contrast can be further raised by making a projection from the ingredient which does not pass the light.
[0028] When forming a domain regulation means in the substrate of one side or both sides, it is possible to form a projection, a hollow, or a slit in the shape of [of an one direction] a grid in a predetermined pitch. In this case, it is possible to perform orientation division more stably by using each projection, a hollow, or a slit as the projection of two or more, hollow, or slit crooked in the predetermined cycle. Moreover, when arranging a projection, a hollow, or a slit to the substrate of both sides, it is desirable that it is made to carry out half-pitch

gap ****** of them.

[0029] Here, in the liquid crystal display indicated by JP,6-301036,A, since opening (slit) is prepared only in a counterelectrode, a domain field cannot be made not much small. On the other hand, in this invention, since a slit is prepared in both a pixel electrode and a counterelectrode, a domain field can be made into the configuration and magnitude of arbitration. It is also possible to arrange a projection or a hollow so that a projection or a hollow may be formed in one substrate side of two upper and lower sides in the shape of [two-dimensional] a grid and an another side side may be countered at the core of a two-dimensional grid.

[0030] make it any -- it is required for the above-mentioned orientation division to arise within 1 pixel, and it is necessary to make the pitch of a projection, a hollow, or a slit smaller than the pitch of 1 pixel According to the result of having investigated the property of LCD which applied this invention, the viewing-angle property was very excellent, and not to mention TN method, even if compared with the IPS method, the viewing-angle property more than an EQC was acquired. From the transverse plane, the property when seeing was also very excellent and were 400 or more (this is twice [more than] the TN method.) contrast ratios. TN method was [30% and the IPS method of permeability] 20%, this invention was 25%, and the IPS method was excelled although it was inferior to TN method. Moreover, the speed of response (response time) was more overwhelmingly [than other methods] quick. If it is an equivalent panel, for example, by TN method Off rate (off time amount) tauoff (5V ->0V) for 23ms in 21ms [ON rate (ON time amount) tauon (0V ->5V)] A speed of response (tau on+tau off) is 44ms, and by the IPS method, 42ms and off rate tauoff are 22ms, and although ON rate tauon was 64ms, a speed of response For example, in the method using the projection of this invention, ON rate tauon was [9ms and off rate tauoff] 15ms in 6ms, and speed of responses were 2.8 times of TN method, and the 4 time high speed of an IPS method, and were rates (responsibility) which are satisfactory at all to a movie display etc.

[0031] Furthermore, by the method of this invention, in order for a projection, a hollow, or slanting electric field to determine the inclination direction of liquid crystal at the time of perpendicular orientation and electrical-potential-difference impression at the time of no electrical-potential-difference impressing, it is not necessary to perform rubbing processing like the usual TN method or an IPS method. Although the rubbing process was a process out of which dust tends to come in the panel production process and substrate washing (it washes in water, IPA, etc.) was surely required after rubbing, the orientation film may be damaged and it had become the cause of poor orientation. On the other hand, in this invention, since the rubbing process is unnecessary, a substrate washing process is unnecessary.

[0032]

[Embodiment of the Invention] Drawing 13 is drawing showing the whole liquid crystal panel configuration of the 1st example of this invention. As shown in drawing 13, the liquid crystal panel of the 1st example The opposite (common) electrode 12 is formed in one glass substrate 16 by LCD of a TFT mold. It corresponds to the intersection of two or more scanning bus lines 31 formed in parallel with the glass substrate 17 of another side, two or more data bus lines 32 formed in parallel with a direction perpendicular to a scanning bus line, and scanning bus lines and data bus lines. TFT33 and the pixel (cel) electrode 13 which were prepared in the shape of a matrix are prepared, as for the front face of each substrate, perpendicular orientation processing is performed, and the closure of the liquid crystal of a negative mold is carried out between two substrates. Since a color filter is formed, a glass substrate 16 is called a color filter substrate (CF substrate), and a glass substrate 17 is called a TFT substrate. It omits about detailed explanation of TFT-LCD, and the configuration of the electrode section which is the description of this invention here is explained.

[0033] Drawing 14 is drawing showing the panel structure of the 1st example of this invention, (1) is drawing showing typically the condition of having seen from across, and (2) is a side elevation. Moreover, drawing 15 is drawing showing relation with the pixel of the projection pattern in the 1st example, drawing 16 is drawing showing the projection pattern besides the viewing area of the liquid crystal panel of the 1st example, and drawing 17 is the sectional view of the liquid crystal panel of the 1st example.

[0034] the ITO film 12 which forms the black matrix layer 34, a color filter 39, and a common electrode in the near front face facing the liquid crystal of the CF substrate 16 as shown in drawing 17 -- reaching -- etc. -- parallel projection 20A is formed in a pitch. In addition, although the perpendicular orientation film is further formed on this, it has omitted here. the ITO film 13 which forms the gate electrode 31 which makes a gate bus line, the CS electrode (storage capacitance electrode) 35, insulator layers 43 and 40, the electrode that makes a data bus line, and a pixel electrode in the near front face facing the liquid crystal of the TFT substrate 17 --

reaching -- etc. -- parallel projection 20B is formed in a pitch. In addition, although the perpendicular orientation film is further formed also with a TFT substrate, it has omitted here. Reference numbers 41 and 42 are the sources and the drains of TFT, respectively. At this example, Projections 20A and 20B were created by TFT flattening material (positive resist).

[0035] As shown in (1) of drawing 14, the projection patterns 20A and 20B are parallel patterns arranged in a pitch, such as extending in the one direction, respectively, and half-pitch gap ****** is carried out. Therefore, structure as shown in drawing 14 (2) is realized, and as drawing 9 explained, orientation division is carried out to two fields. The relation to the pixel of such a projection pattern is shown in drawing 15. As shown in drawing 15, generally with the liquid crystal display of color display, one color pixel is formed by three pixels, R, G, and B. a color pixel -- the upper and lower sides -- it is arranged in the same pitch -- as -- the breadth of each pixel of R, G, and B -- about [of a dip] -- it is made one third. A pixel is the range of a pixel electrode, between the arranged pixel electrodes, a gate bus line (it is hiding in the bottom of projection 20B.) is prepared in a longitudinal direction, the data bus line 32 is established in the lengthwise direction, TFT33 is prepared near the intersection of the gate bus line 31 and the data bus line 32, and each pixel electrode is connected. The black matrix 34 for protection from light is formed in the opposite side of the gate bus line 31 of each pixel electrode 13, the data bus line 32, and TFT33. Since a reference number 35 shows CS electrode for forming the auxiliary capacity prepared for stability of a display and CS electrode has protection-from-light nature, the part of CS electrode of the pixel electrode 13 does not act as a pixel. Therefore, a pixel is divided into the parts of upper 13A and lower 13B.

[0036] Within pixel 13A and 13B, three projection 20A runs, respectively, four projection 20B runs, and the 1st field where projection 20B is located in the bottom and projection 20A is located in the bottom, and the 2nd three fields where projection 20A is located in the bottom and projection 20B is located in the bottom are formed at a time, respectively. Therefore, in one pixel which doubled Pixels 13A and 13B, the 1st and the 2nd six fields are formed at a time, respectively.

[0037] As shown in drawing 16, in the periphery of a liquid crystal panel, the projection patterns 20A and 20B were formed also in the outside of a pixel at the very end, and the projection patterns 20A and 20B are prolonged even on the outside of a pixel at the very end. This is because orientation division is performed like an internal pixel about the outermost pixel. Moreover, drawing 18 is drawing showing the location of the inlet of the liquid crystal in the liquid crystal panel 100 of the 1st example. After sticking CF substrate and a TFT substrate like the assembler of a liquid crystal panel, although liquid crystal is poured in, LCD of a VA mold TFT method has narrow cel thickness, the time amount of liquid crystal impregnation becomes long, so that it may mention later, but in order to prepare a projection, the time amount of liquid crystal impregnation becomes long further. In order to shorten time amount of liquid crystal impregnation as much as possible, as shown in (1) of drawing 18, it is desirable to form the inlet 102 of liquid crystal the perpendicular side of the array direction of the projection 20 arranged in parallel periodically. In addition, a reference number 101 is a seal line.

[0038] Moreover, while pouring in liquid crystal, if the gas in a panel is exhausted from the exhaust port 103 established in other parts, an internal pressure will decline and impregnation of liquid crystal will become easy. Also about an exhaust port 103, as shown in (2) of drawing 18, it is desirable to prepare in the side of the opposite side of an inlet 102. The 1st example shows the configuration which measured what was actually made as an experiment by the sensing-pin type thickness gage to drawing 19. Like illustration, spacing of the ITO electrodes 12 and 13 formed on the substrate is regulated so that it may be set to 3.5 micrometers with a spacer 45. Height is [1.5 micrometers and width of face] 5 micrometers, the up-and-down projections 20A and 20B leave 15 micrometers of projections 20A and 20B, and they are arranged. Therefore, spacing of the adjoining projection formed on the same ITO electrode is 30 micrometers.

[0039] The orientation stabilized very much was obtained in the result which impressed the middle electrical potential difference to the panel of the 1st example, and was observed under the microscope. Furthermore, by the panel of the 1st example, the speed of response has improved very much. Drawing 20 and drawing 21 are drawings showing the speed of response when changing the gap of a projection of applied voltage and the upper and lower sides as a parameter in the panel of the 2nd example, and (1) of drawing 20 shows the switching rate to which (2) applied the OFF rate (5 ->0V) to, and drawing 21 applied the ON rate (0 ->5V) for the ON rate and the OFF response. Although it hardly depends for falling time amount tauoff on a gap as shown in drawing 20 and drawing 21, build-up-time tauon changes a lot. As a gap becomes small, a speed of response becomes quicker. In addition, although the cel thickness of this cel was 3.5 micrometers, the practical die length of this

gap changes somewhat with cel thickness. That is, it will become narrow, if breadth and cel thickness become thick when cel thickness is thin. When spacing was to about 100 times of cel thickness, it actually checked that liquid crystal fully carried out orientation.
[0040] make it any -- switching rate sufficient by the panel of the 1st example was obtained. For example, off time amount tauoff is 6ms, ON time amount tauon of the speed of response of 0-5V at the time of 15 micrometers and 3.5 micrometers of cel thickness is 9ms about spacing of a projection, and ultra high-speed switching is [the switching rate tau is 15ms and] possible for it. Drawing 22 to drawing 24 is drawing showing the viewing-angle property of the panel of the 2nd example. Drawing 22 shows change of the contrast by the viewing angle two-dimensional, and drawing 23 and drawing 24 show the change to the viewing angle of the display brightness of 8 gradation. (1) of drawing 23 shows change [in / for change / in / for change / in / for change / in / for the change in 90 degrees of azimuths / in (2) / 45 degrees of azimuths / in (3) / 0 degree of azimuths / in (1) of drawing 24 / -45 degrees of azimuths / in (2) / -90 degrees of azimuths]. In drawing 22, contrast shows ten or less field and the part of a double slash shows [the part of a slash] a five or less contrast field. Like illustration, although the in general good property was acquired, since it is vertical 2 division, it is not a property with the completely equal right-and-left upper and lower sides like the 1st example. In the vertical direction, the fall of contrast is somewhat large compared with a longitudinal direction. In a longitudinal direction, although there are few falls of contrast compared with the vertical direction, as shown in (3) of drawing 23, black tone reversal occurs near 30 degree. Since a polarizing plate is stuck in the combination from which an absorption shaft becomes 45 degrees and 135 degrees, the viewing-angle property of the direction of slant is very good. Although excelled also in as [this] more overwhelmingly than TN method, it is inferior to the IPS method a little in respect of the viewing-angle property. However, it is possible to improve a viewing-angle property further and to carry out to more than an IPS method by arranging a phase contrast film one sheet on the panel of the 1st example. Drawing 25 and drawing 26 are drawings showing the viewing-angle property at the time of using a phase contrast film on the panel of the 1st example, and are drawing corresponding to drawing 22 and drawing 23, respectively. Like illustration, it has been improved dramatically and the fall also of the tone reversal of a longitudinal direction of the contrast by the viewing angle was lost. Conversely, generally, although the tone reversal in a white display has occurred in the vertical direction, since human being's eyes hardly understand the reversal in a white display, it seldom becomes a problem as display quality. Thus, in all the fields of a viewing-angle property, a speed of response, and the difficulty of manufacture, the property exceeding an IPS method was acquired by using a phase contrast film.
[0041] With the configuration of the 1st example, various kinds of deformation was performed, and the parameter except having described above was changed and the optimal conditions were examined. In a projection, if it indicates by black, light will leak in a projection part. Drawing 27 is drawing explaining generating of the leakage light in this projection part. Since orientation of the light which carried out incidence like illustration at right angles to the part in which the projection 20 was formed with the electrode 13 of a bottom substrate is aslant carried out like [in the slant face of projection 20] illustration of a liquid crystal molecule, light is penetrated to some extent and becomes a halftone display. On the other hand, in the top-most-vertices part of a projection, orientation of the liquid crystal molecule is carried out perpendicularly, and light does not leak from a top-most-vertices part. This will be the same also about the electrode 12 of a top substrate, and, in a black display, a halftone display and a black display will be partially performed in a projection part. Although the difference of such a partial display is microscopic and it cannot distinguish with the naked eye, the whole display will be the averaged display reinforcement, and the display concentration of a black display falls a little, and reduces contrast. Therefore, contrast can be raised by making a projection from the ingredient which does not pass the light. Contrast can be further raised by making a projection also from the 1st example with the ingredient which does not pass the light.
[0042] Although change of the speed of response when changing the gap of a projection was shown in drawing 20 and drawing 21, it was made to change also about the height of a projection and change of a property was measured. 7.5 micrometers, 15 micrometers, and cel thickness set to about 3.5 micrometers the width of face and the gap of a resist which form a projection, respectively, they set the height of a resist to 1.537 micrometers, 1.600 micrometers, 2.3099 micrometers, and 2.4486 micrometers, and measured permeability and a contrast ratio with the experimental device. The result is shown in drawing 28 and drawing 29. Moreover, the change to the height of the projection (resist) of contrast by the change to the height of a projection (resist) of transmission [in / for the change to the height of a projection (resist) of the transmission in confession voice (at the time of

5V impression) / a black condition (at the time of no electrical-potential-difference impressing)] in drawing 31 is shown in drawing 30 from this result at drawing 32. If a resist becomes high, according to it, confession voice (at time of electrical-potential-difference impression) permeability will also increase. Since this has the large projection (resist) which bears the auxiliary role for making liquid crystal incline, it is considered to be for a liquid crystal molecule to fall more certainly. The more the height of a resist also increases the transmission (leakage light) in a black condition (at the time of no electrical-potential-difference impressing), the more it increases. This is not so desirable in order to act in the direction on which black level is dropped. Drawing 27 explains the cause of this leakage light. Right above a projection (resist) and in the gap section, the liquid crystal molecule is perpendicular to a substrate front face. Optical leakage is not generated from this part. However, in the ramp of a projection, the liquid crystal molecule is carrying out orientation with some inclination. If a projection becomes high, the area of this ramp will also increase and leakage light will increase.

[0043] Therefore, contrast (white brightness / black brightness) is in the inclination to fall, so that a resist becomes high. However, since contrast is high from the first, a good display can be performed even if it increases to the same height as cel thickness. In this case, the role of a panel spacer can be made a projection (resist) so that it may mention later. Based on these results, height made the liquid crystal display of 15 molds as an experiment using the TFT substrate and CF substrate which have the projection which are 0.7 micrometers, 1.1 micrometers, 1.5 micrometers, and 2.0 micrometers. Although it appeared also in the liquid crystal panel which the inclination as a result of the above-mentioned experiment actually manufactured, in actual observation, the panel manufactured on which conditions is also the level from which the fall of contrast does not become a problem, and the good display was obtained. this -- from the first -- high -- since it is a contrast panel, even if contrast falls somewhat, human being's eyes seem ** which cannot be distinguished. Moreover, although the height of a projection also manufactured the panel which is 0.7 micrometers in order to discern the limitation of a side with the small height of the projection in which liquid crystal carries out orientation, the completely normal display was obtained. Therefore, even if a projection (resist) is thin thickness 0.7 micrometers or less, it can fully carry out orientation of the liquid crystal molecule.

[0044] Drawing 33 is drawing showing the projection pattern of the 2nd example. As shown in drawing 15, in the 1st example, a projection is a straight line-like and the projection was prolonged in the direction perpendicular to the longer side of a pixel. The projection is made to extend in the direction perpendicular to the side of the shorter one of a pixel 9 in the 2nd example. Other parts of the 2nd example are the same as the 1st example. Drawing 255 is drawing showing the modification of the 2nd example, (1) shows a projection pattern and (2) shows the sectional view of projection arrangement. It passes along the core of a pixel 9 and projection 20A prepared on the electrode 12 by the side of the CF substrate 16 is made to extend in the direction perpendicular to the side of the shorter one of a pixel 9 in this modification. A projection is not prepared in the TFT substrate 17 side. Therefore, orientation of the liquid crystal is carried out in the two directions into each pixel. As shown in (2) of drawing 255, a domain is divided by projection 20A in the center of a pixel. Moreover, since the edge of a pixel electrode works as a domain regulation means around the pixel electrode 13, stable orientation division can be performed. Although the projection of one per pixel is only prepared, and a speed of response falls from the 2nd example in this modification since the distance of projection 20A and the edge of the pixel electrode 13 is long, a projection is only prepared in one side of a substrate, and is easy a production process. Furthermore, since the area which a projection occupies within a pixel is small, display brightness can be made high.

[0045] Drawing 256 is drawing showing the projection pattern of another modification of the 2nd example. Projection 20A prepared on the electrode 12 by the side of the CF substrate 16 is prepared in the core of a pixel 9. The projection is not prepared in the TFT substrate 17 side. Projection 20A is a square drill. Therefore, orientation of the liquid crystal is carried out in the four directions into each pixel. Since the area which the same effectiveness as the modification of drawing 255 is acquired, and a projection occupies within a pixel also in this modification is still smaller, display brightness improves further.

[0046] Although much projections of the straight line prolonged in an one direction were prepared in parallel in the 1st example and the 2nd example, the orientation division produced by this projection is mainly two fields, and 180 degrees of bearings when a liquid crystal molecule carries out orientation will differ in two fields. Although the viewing-angle property of halftone is improved now as the component within a field including bearing perpendicular to a substrate which carries out orientation was shown in drawing 9, about a component

perpendicular to it, a problem as shown by drawing 7 arises. Therefore, as for orientation division, it is desirable that they are four directions.

[0047] Drawing 34 is drawing showing the projection pattern of the 3rd example. As shown in drawing 34, in the 3rd example, the projection pattern prolonged in a lengthwise direction and the projection pattern prolonged in a longitudinal direction are prepared in 1-pixel 9. Here, the projection pattern prolonged in a longitudinal direction in a lower half in the projection pattern prolonged in a lengthwise direction is prepared in the 1-pixel upper half. If it is this, since orientation division will be carried out to two fields in the bearing which is different 180 degrees in a longitudinal direction with the projection pattern prolonged in a lengthwise direction and orientation division will be carried out to two fields in the bearing which is different 180 degrees in a lengthwise direction with the projection pattern prolonged in a longitudinal direction, orientation division will be carried out in the four directions within 1-pixel 9. Therefore, when it considers as a liquid crystal panel, the viewing-angle property of the vertical direction and the both directions of a longitudinal direction will be improved. In addition, in the 3rd example, it is the same as the 1st example except a projection pattern.

[0048] Drawing 35 is drawing showing the example which transformed the projection pattern of the 3rd example, and it differs from the projection pattern of drawing 34 in that the projection pattern prolonged in a longitudinal direction in a right half in the projection pattern prolonged in a lengthwise direction is prepared in the 1-pixel left half. Also in this case, like the projection pattern of drawing 34, orientation division will be carried out in the four directions within 1-pixel 9, and the viewing-angle property of the vertical direction and the both directions of a longitudinal direction will be improved.

[0049] Although the projection was used as a domain regulation means to produce orientation division, in the 1st to 3rd example, as shown in drawing 36, in the summit section of a projection, the orientation of a liquid crystal molecule is not regulated at all. Therefore, in the summit section of a projection, the orientation of liquid crystal is not controlled but display quality is reduced. The 4th example is an example which solves such a problem.

[0050] Drawing 37 is drawing showing the projection configuration of the 4th example, and other parts are the same as the 1st to 3rd example. In the 4th example, as shown in (1) of drawing 37, projection 20 is made into the configuration which has a taper in a part. Spacing of a taper part is good at about (or 50 micrometers or less) 50 micrometers. In order to create such a projection pattern, a projection pattern is formed by the positive form resist, and a projection and a taper are formed by SURAITO etching. If it is this, orientation will be controlled also in the summit section of a projection.

[0051] Moreover, in the modification of the 4th example, as shown in (2) of drawing 37, the projection 46 which has a taper is further formed after projection 20. Also in this case, spacing of a taper part is good at about (or 50 micrometers or less) 50 micrometers. In order to create such a projection pattern, a projection pattern is formed by the positive form resist, and projection 20 is formed by SURAITO etching. Furthermore, the positive form resist of the thickness of one half extent of a projection is formed, and it leaves the projection part 46 to which the taper after projection 20 was attached by SURAITO etching. Orientation is controlled [in / similarly / in this / the summit section of a projection]. Drawing 38 is drawing showing the panel structure in the 5th example, (1) is drawing showing typically the condition of having seen from across, and (2) is a side elevation. The 5th example is an example corresponding to the structure of (3) of drawing 12. It formed in the electrode 12 formed in the front face of one substrate like illustration of projection 20A by the positive resist, and the slit 21 is formed in the electrode 13 of the substrate of another side. In fact, the 5th example uses as a slit 21 projection pattern 20B prepared in the pixel electrode 13 of the 3rd example, and the pixel electrode 13 has a pattern as shown in drawing 39.

[0052] The problem of cost is in the important requirements which determine a commercial success of a liquid crystal display. As mentioned above, although display quality improves by forming a domain regulation means in the liquid crystal display of VA method, it is required for there to be a problem that the part cost which establishes a domain regulation means becomes high, and to realize a domain regulation means by low cost. So, in the 5th example, the domain regulation means by the side of the TFT substrate 17 which has an active element is used as the slit of the pixel electrode 13, and the domain regulation means by the side of the color filter substrate 16 which counters is considered as a projection.

[0053] While etching, the process for it increasing and cost's increasing after carrying out pattern exposure after applying a photoresist, and developing negatives when preparing a projection on an electrode, there is a problem that the yield also falls. On the other hand, it is necessary to carry out pattern NINGU of the pixel

electrode 13, and to form it, and even if it forms the pixel electrode which has a slit 21, a process does not increase it. Therefore, it is lower for cost to make a slit into a domain regulation means from a projection in a TFT substrate side. On the other hand, since it is usually a solid electrode, the process etched after developing the above photoresists which carried out pattern NINGU is required for the counterelectrode of a color filter substrate (CF substrate) when preparing a slit in a counterelectrode, but the developed photoresist can use it as it is when forming a projection on a counterelectrode, the increment in cost has little direction which forms a projection. Therefore, the increment in cost can be made small by using the domain regulation means by the side of a TFT substrate as the slit of a pixel electrode, and considering the domain regulation means by the side of a color filter substrate as a projection like the liquid crystal display of the 5th example.

[0054] When a slit is prepared in a pixel electrode and it divides into two or more partial electrodes, it is necessary to impress the same signal level to each partial electrode, and to prepare the electrical installation part which connects partial inter-electrode one. Since the orientation of liquid crystal is in disorder in an electrical installation part so that it may mention later when this electrical installation part is prepared in the same layer as a pixel electrode, the problem that the display brightness and speed of response of the top of the panel to which a viewing-angle property falls fall arises.

[0055] So, in the 5th example, as shown in drawing 39, brightness equivalent to the case where a projection is prepared in both, and a speed of response have been obtained by shading an electrical installation part by BM34. In this example, the CS electrode 35 is formed in the center section of the pixel, and since the CS electrode 35 is protection-from-light nature, a pixel is divided into the part of two upper and lower sides. Reference number 34A shows opening of the top by BM, 34B shows opening of the bottom by BM, and the inside of opening passes light.

[0056] Since bus lines, such as the gate bus line 31 and the data bus line 32, are made from a metallic material, they have protection-from-light nature. In order to perform the stable display, it is necessary to form a pixel electrode so that it may not lap with a bus line, and it needs to shade between a pixel electrode and bus lines. Moreover, since a component property may change with the incidence of light and this actuation may break out when the amorphous silicon is used as a semi-conductor of operation, the part of TFT also needs to shade especially TFT33. Therefore, BM34 for shading these parts is formed from the former, and since it is prepared in the periphery whose electrical installation part is a pixel, it can shade by BM34 at this example. Moreover, in order for what is necessary just to be not to newly prepare BM for shading an electrical installation part, and to extend BM the conventional BM or a little, it is extent from which decline in a numerical aperture does not become a problem, either.

[0057] Since the panels of the 5th example are 2 division methods, various kinds of properties are completely fundamentally the same as the 1st example, and the viewing-angle property has also been sharply improved compared with TN method. Furthermore, it becomes the same viewing-angle property as the panel of the 1st example by using a phase contrast film. ON rate tauon is still 8ms, and off rate tauoff is 9ms, and if it is measured against the conventional method, it is [it is the switching rate tau in 17ms and] far high-speed [since the speed of response is using the slanting electric field by the slit for one side, it is slower than the 1st example a little, but]. The manufacture process is easy compared with the 1st example.

[0058] Here, a slit is prepared in a pixel electrode as reference, and a counterelectrode explains the result when making the liquid crystal display used as the solid electrode as an experiment. Since two or more slits of a 2-way were prepared and many domain fields of four directions were formed in a pixel, the stable orientation which carried out orientation to about 360-degree omnidirection was obtained by the pixel electrode. Therefore, the viewing-angle property is very good and the equal image was obtained in 360-degree omnidirection. However, the speed of response has not improved, but ON rate tauon is 42ms, and the switching rate at which off rate tauoff is 15ms and totaled them is 57ms, and has seldom improved. If the number of a slit is reduced, a speed of response will fall further. This is considered to take time amount, before the part domain field will become large and all the liquid crystal molecules in a domain field will carry out orientation in the same direction, if the number of a slit is reduced.

[0059] Therefore, the configuration which uses only a slit as a domain regulation means has the advantage that a process is made simple, and although it is satisfactory to the display which is mainly concerned with a still picture, it cannot be said like an IPS method that it is enough for a movie display. In the 5th example, when an electrical potential difference was impressed, it turned out that the part by which orientation is not stabilized exists in some places. The reason is explained with reference to drawing 40 and drawing 41. Although drawing

40 is drawing explaining orientation distribution of the liquid crystal in an electrical installation part, and liquid crystal will carry out orientation of it in the direction perpendicular to the direction in which a projection and a slit are prolonged in the part in which projection 20A and a slit 21 are formed in parallel if it is seen from a top, in an electrical installation part, liquid crystal molecule 14a by which orientation is carried out in the different direction exists, and the abnormalities in orientation produce it. Therefore, although orientation of the liquid crystal molecule is carried out perpendicularly (the vertical direction of drawing) to projection 20A and a slit 21 in the gap part of projection 20A and the electrode slit 21 as shown in drawing 41, the summit of a projection, and near the center of a slit, a liquid crystal molecule is not perpendicular and carries out orientation horizontally. Although the slanting electric field by the inclination and slit of a projection could control liquid crystal in the vertical direction in drawing, since it was uncontrollable to a longitudinal direction, the summit of a projection, and near the center of a slit, it was checked by the observation under a microscope that the random domain 47 occurs in a longitudinal direction. Since the domain of the summit of a projection is so small that it cannot be distinguished, it does not become a problem, but when brightness falls, at the time of the change in white from black, white may become once more bright and it may be visible in the part which such abnormalities in orientation produce, as an after-image. This problem is solved in the 6th following example.
[0060] The panel of the 6th example changes the configuration of the slit 21 of projection 20A in the panel of the 5th example, and the cel electrode 13. Drawing 42 is drawing showing the fundamental configuration when seeing projection 20A and the cel electrode 13 in the 6th example from a direction perpendicular to a panel. Zigzag is made crooked and the slit 21 of the cel electrode 13 is also making projection 20A crooked in zigzag like illustration according to it. The domain regularly quadrisected by this as shown in drawing 43 is generated. Therefore, the abnormality section in orientation which became a problem in the 5th example is cancelable.
[0061] Drawing 44 is the top view showing the actual situation of the picture element part of the 6th example, drawing 45 is drawing showing the pattern of the pixel electrode of the 6th example, and drawing 46 is the sectional view of the part shown by A-B of drawing 44. drawing 44 -- and -- drawing 46 -- being shown -- as -- the -- six -- an example -- LCD -- **** -- one side -- a glass substrate -- 16 -- **** -- protection from light -- ** -- black -- a matrix -- (-- BM --) -- 34 -- a color separation filter (color filter) -- 39 -- forming -- having -- the -- a top -- the whole surface -- common -- an electrode -- 12 -- forming -- having -- further -- zigzag -- a projection -- a train -- 20 -- A -- forming -- having -- **** . TFT33 and the pixel electrode 13 which were prepared in the shape of a matrix corresponding to the intersection of two or more scanning bus lines 31 formed in parallel with the glass substrate 17 of another side, two or more data bus lines 32 formed in parallel with a direction perpendicular to a scanning bus line, and scanning bus lines and data bus lines are prepared. The scanning bus line 31 forms the gate electrode in TFT33, and the data bus line 32 is connected to the drain electrode 42 in TFT33. Moreover, the source electrode 41 is the same layer as the data bus line 32, and is formed in the drain electrode 42 and coincidence. Between the layers of the scanning bus line 31 and the data bus line 32, gate dielectric film, an a-Si barrier layer, and a channel protective coat are formed in a predetermined part, an insulator layer is formed on the layer of the data bus line 32, and the ITO film which is further equivalent to the pixel electrode 13 is formed. The pixel electrode 13 is the rectangle of 1:3 as shown in drawing 45, and two or more slits 21 are formed in the direction to which 45 degrees inclined to the side. Furthermore, in order to stabilize the potential of each pixel electrode 13, the CS electrode 35 is formed and auxiliary capacity is formed. A glass substrate 17 is called a TFT substrate.
[0062] Like illustration, although the slit 21 of projection train 20A of CF substrate and a TFT substrate shifts, and is arranged only one half of each array pitches and the relation of a substrate is reverse, physical relationship of a projection and a slit as shown in (3) of drawing 12 is realized, and the orientation of liquid crystal is divided in the four directions. As mentioned above, the pixel electrode 13 applies a photoresist on it, after forming the ITO film, and it is formed by etching, after exposing and developing the pattern of an electrode. Therefore, if pattern NINGU is carried out so that the part of a slit may be removed, a slit can be formed at the same process as the former, and cost will not increase.
[0063] In the 6th example, as shown in drawing 45, the part of the peripheries 131, 132, and 133 of the pixel electrode 13 leaves an electrode, and is using it as the electrical installation part. As mentioned above, in the 6th example, since the orientation of liquid crystal is in disorder in an electrical installation part, as shown in drawing 45, the electrical installation part was prepared in the periphery of the pixel electrode 13, BM which has top opening 34A and bottom opening 34B was used, and brightness equivalent to the case where a projection is prepared in both, and a speed of response have been obtained by shading an electrical installation

part with BM and the CS electrode 35.
[0064] Drawing 47 and drawing 48 are drawings showing the viewing-angle property in the 6th example. Thus, the viewing-angle property is very good and most of the abnormality section in orientation was not admitted. Moreover, the switching rate tau is 17.7ms and ultra high-speed switching is possible for a speed of response. Drawing 49 is the modification of the pattern of a pixel electrode, and forms BM34 as shown in (2) to the pixel electrode 13 of drawing 49 as shown in (1). In addition, the pattern of a pixel electrode can consider various kinds of modifications, for example, prepares an electrical installation part in the periphery of the both sides of a slit, and may be made to make each partial inter-electrode resistance small.
[0065] In addition, in the 5th and 6th examples, although it is also possible to prepare a slit instead of the projection prepared on the counterelectrode 12 of the CF substrate 16, and to use both domain regulation means as a slit, a speed of response falls as mentioned above in that case. In the 6th example, although the electrical installation part was the same layer as a partial electrode, it can also be formed in another layer. The 7th example is such an example.
[0066] Drawing 50 is drawing showing the pattern and structure of a pixel electrode in the 7th example. The 7th example is the same as the 6th example except forming the connection electrode 132 in coincidence at the time of data bus line 32 formation, and forming the contact hole which connects the pixel electrode 13 divided into the insulating layer 135, and the connection electrode 134. In addition, in this example, although the connection electrode 134 was formed in the data bus line 32 and coincidence, you may form in the gate bus line 31 or the CS electrode 35, and coincidence. In addition, although a connection electrode may be formed separately from formation of a bus line, it is necessary to newly establish the process for connection electrode formation in this case, and that much new process will increase. As for a connection electrode, for simplification of a process, it is desirable to form in coincidence at the time of formation of a bus line or CS electrode.
[0067] In the 7th example, since the connection electrode leading to the abnormalities in orientation can be kept away from a liquid crystal layer compared with the 6th example, the abnormalities in orientation can be reduced further. In addition, if a connection electrode is formed with the ingredient of protection-from-light nature, since the part will be shaded, display quality improves further. Drawing 51 is the top view of the picture element part of the 8th example, and drawing 52 is the sectional view of the part of A-B of drawing 51. The 8th example is the same as the 6th example except having formed projection 20C in the slit of the pixel electrode 13. The slit of an electrode and the insulating projection prepared on the electrode specify the orientation field of liquid crystal. Like the 8th example, when projection 20C is prepared in a slit 21, the direction of orientation of the liquid crystal by the slit 21 and projection 20C is in agreement, and projection 20C assists division of the orientation by the slit 21, and it works so that you may make it stabilized more. Therefore, from the 6th example, orientation is stabilized and a speed of response also improves. As shown in drawing 52, projection 20C is realized by piling up the layer formed in coincidence, when forming the CS electrode 35, the gate bus line 31, and the data bus line 32, respectively.
[0068] Drawing 53 and drawing 54 are drawings explaining the manufacture approach of the TFT substrate of the 8th example. As shown in (1) of drawing 53, the metal (metal) film 311 of a gate layer is formed to a glass substrate 17. It leaves the part 312 equivalent to the gate bus line 31, the CS electrode 35, and projection 20C by the photolithography method by (2). Continuation membrane formation of gate dielectric film 313, an a-Si barrier layer, and the channel protective coat 313 is carried out by (3). It leaves the part 314 which is equivalent to the channel protective coat 65 and projection 20C in self align by (4) with tooth-back exposure etc. The metal 321 of a contact layer and a source drain layer is formed by (5) of drawing 54. The source electrode 41, the drain electrode 42, etc. are formed by the photolithography method by (6). At this time, it also leaves the metal film to the location equivalent to projection 20C inside a slit. The passivation film 331 is formed by (7). The contact hole 332 of the source electrode 36 and a pixel electrode is formed by (8). The ITO film 341 is formed by (9). The pixel electrode 13 is formed by the photolithography method by (10). A slit is prepared at this time.
[0069] As mentioned above, in this example, although projection 20C is formed in the slit 21 of the pixel electrode 13, compared with the former, there is no increment in a process and the effectiveness that orientation is further stabilized by projection 20C is acquired. In addition, although three layers, a gate bus-line layer, a channel protective coat layer, and a source drain layer, were considered for the projection in the slit of a pixel electrode as the projection in piles, it is one layer or you may make it form a projection in this example combining two-layer.
[0070] Drawing 55 is drawing showing the configuration when seeing the projections 20A and 20B in the 9th

example from a direction perpendicular to a panel, and drawing 56 is drawing showing the actual top view of the picture element part of the 9th example. The panel of the 9th example of this invention makes the configuration of the projections 20A and 20B in the panel of the 1st example crooked in zigzag like the 6th example, and the orientation of quadrisection was obtained. Since the 90 degrees of the directions of a projection side differ at a time and they carry out orientation of the liquid crystal molecule in the perpendicular direction on the surface of a projection on both sides of a straight part, the orientation of quadrisection is obtained. The thickness (cel thickness) of a liquid crystal layer is 4.1 micrometers, and width of face is [the height of projection 20A of CF substrate] specifically 1.4 micrometers in 10 micrometers. Width of face was [height] 1.2 micrometers in 5 micrometers, the gap (gap of the direction to which 45 degrees inclined by a diagram) of Projections 20A and 20B is 27.5 micrometers, and, as for projection 20B of a TFT substrate, the pixel dimension (pixel array pitch) manufactured the panel of the conditions which are 99micrometerx297micrometer. Consequently, the speed of response was the same as the 1st example, the viewing-angle property was the same as the property of the 6th example, and it was a very good property with equal four directions. A projection ingredient also involves and the optimal width of face of a projection, height, and a gap change further also according to the conditions of **, such as an orientation film ingredient, a liquid crystal ingredient, and cel thickness, while they are deeply related mutually.

[0071] The inclination direction of liquid crystal is controllable by the panel of the 9th example mainly in the four directions. Although the field where the part shown by A, B, C, and D is controlled by drawing 55 in these four directions is shown, the ratio in that 1 pixel is not equal. In order that this may make a projection pattern the continuous thing and a projection pattern may arrange it in the same location by each pixel, it is because the repeat pitch of a projection pattern is doubled with the array pitch of a pixel. Although the viewing-angle property shown in drawing 47 and drawing 48 in fact is acquired and the inhomogeneity of the field of orientation division had not appeared in a viewing-angle property, it is there where it cannot be said as a not much desirable condition, and the projection pattern of drawing 55 was disregarded and formed for the pixel pitch all over the substrate. The width of face of the resist made 7 micrometers and a resist gap 15 micrometers, resist height of 1.1 micrometers, and 3.5 micrometers of cel thickness, and made the liquid crystal display of 15 molds as an experiment using the TFT substrate and CF substrate. Although the interference pattern with a gate bus line, a data bus line, etc. was seen a little, the in general good display was obtained. Although 15-micrometer resist gap was made to increase the width of face of a resist to 30 micrometers, it was the almost same result. therefore, even if a pixel dimension is disregarded and it forms a projection pattern by making the width of face of a projection, and a repeat pitch into a value sufficiently smaller than a pixel pitch, a good display obtains -- having -- in addition -- and the degree of freedom of a design will spread. It is solvable by setting up a projection or the repetition pitch of the pattern of a hollow for losing an interference pattern completely at 1 or the integral multiple for an integer of a pixel pitch. Similarly, the cycle of a projection also needs the design in consideration of the period of a pixel, and its 1 or integral multiple for an integer of a pixel pitch is desirable.

[0072] In addition, if a projection pattern is made into what does not continue as shown in drawing 57 in the 9th example, the ratio of the field controlled in the four directions within 1 pixel can equalize. However, even if it is this, a manufacture top does not have especially a problem. However, since a projection pattern does not continue and the direction of orientation of liquid crystal is in disorder in the edge part, deterioration of display quality, such as optical leakage, is produced. It is desirable to use the repeat pitch of a projection pattern as the continuous projection pattern like drawing 55 also from such a point according to the array pitch of a pixel.

[0073] In the 9th example, the projection of the dielectric crooked in zigzag was prepared on an electrode 12 and 13 as a domain regulation means, and this has regulated the direction of orientation of liquid crystal. As mentioned above, if a slit is prepared in an electrode, slanting electric field will arise into the edge part, and it will work as a domain regulation means similar to a projection. Slanting electric field are similarly generated about the edge of a pixel electrode. Therefore, it is necessary to also take into consideration slanting electric field with the edge of a pixel electrode as a domain regulation means. Drawing 58 is this drawing that gives phenomenon explanation, and shows the case of the inclination perpendicular orientation to which it inclined a little perpendicularly here. As shown in (1) of drawing 58, when not impressing an electrical potential difference, orientation of each liquid crystal molecule 14 is carried out almost perpendicularly. If an electrical potential difference is impressed among electrodes 12 and 13, in the field except the periphery of an electrode 13, electric field will occur in the direction perpendicular to electrodes 12 and 13, and the liquid crystal

molecule 14 will incline in the direction perpendicular to this electric field. Although one electrode is a common electrode, the electrode of another side is a display pixel electrode, and since it has dissociated for every display pixel, as shown in (2) of drawing 58, the direction of electric field 8 inclines in the periphery (edge) section. Since the liquid crystal molecule 14 inclines in the direction which becomes perpendicular to the direction of electric field 8, the inclination directions of liquid crystal differ with the core and edge of a pixel like illustration, and it generates the phenomenon called a reverse tilt. If this reverse tilt occurs, a schlieren organization will be formed in a display pixel field, and display quality will deteriorate.

[0074] Generating of such a reverse tilt is also the same as when establishing a slanting bank in zigzag to a pixel electrode edge like the 9th example. Drawing 59 is drawing showing the part 51 in which it gazed at the schlieren organization in the configuration which prepared the projection pattern crooked in the zigzag of the 9th example. Moreover, drawing 60 is drawing which expanded near the part 51 where it gazed at the schlieren organization, and the inclination direction of the liquid crystal molecule 14 at the time of electrical-potential-difference impression is shown. In this example, with the pixel electrode substrate with which TFT is formed as a projection ingredient, and the opposite substrate with which a common electrode is formed, the projection was formed with a different ingredient and it assembled, without printing the perpendicular orientation film and carrying out rubbing processing on it. Cel thickness could be 3.5 micrometers. The part 51 in which it gazed at the schlieren organization is a part where the inclination direction of the liquid crystal molecule toppled by the orientation restraining force by slanting electric field differs from the orientation regulation direction by projection greatly at the time of electrical-potential-difference impression. It becomes the cause by which this reduces contrast, reduces a speed of response, and reduces display quality.

[0075] Moreover, when the liquid crystal display of a configuration of having prepared the projection pattern crooked in the zigzag of the 9th example was driven, it set to a part of display pixel, and the display became dark and the phenomenon called the after-image a pre- display remains and is in sight for a while in the display of an animation, a cursor advance, etc. occurred. Drawing 61 is drawing showing the field which looks black within a pixel in the liquid crystal panel of the 9th example. In this field, it turned out that change of the orientation condition at the time of electrical-potential-difference impression is very slow.

[0076] (1) of drawing 62 is the sectional view of A-A' in drawing 61, and (2) of drawing 62 is the sectional view of B-B'. Although there is a field which looks [show / in drawing 61] black near a left-hand side edge in the cross section of A-A', there is no field which looks black near a right-hand side edge. Although the inclination direction of the liquid crystal molecule toppled by the orientation restraining force by slanting electric field differs from the orientation regulation direction by projection greatly near a left-hand side edge corresponding to this as shown in (1) of drawing 62, near a right-hand side edge, the inclination direction of the liquid crystal molecule toppled by the orientation restraining force by slanting electric field and the orientation regulation direction by projection are comparatively in agreement. Although similarly the field which looks black is near a right-hand side edge in the cross section of B-B' Although the inclination direction of the liquid crystal molecule toppled by the orientation restraining force by slanting electric field differs from the orientation regulation direction by projection greatly near a right-hand side edge as there is no field which looks black near a left-hand side edge and it is shown in (2) of drawing 62 corresponding to this Near a left-hand side edge, the inclination direction of the liquid crystal molecule toppled by the orientation restraining force by slanting electric field and the orientation regulation direction by projection are comparatively in agreement.

[0077] As mentioned above, it turns out at the time of electrical-potential-difference impression that the part where the inclination direction of the liquid crystal molecule toppled by the orientation restraining force by the slanting electric field of the edge of a display pixel electrode differs from the orientation regulation direction by projection greatly is the cause of degradation of display quality. Moreover, when the liquid crystal display of a configuration of having prepared the projection pattern was driven, degradation of display quality was seen [near the bus line (a gate bus line, data bus line)] within the pixel. This is for the very small field (domain) which is not desirable to occur near the bus line, and for turbulence and a speed of response to fall [the orientation of liquid crystal] with the generating. Thereby, problems in halftone, such as a fall of a viewing-angle property and a fall of a color property, have occurred.

[0078] Drawing 63 is drawing showing basic arrangement of the projection in LCD of the 10th example. The range specified with the cel electrode 13 acts as a pixel, and this part is made to call a viewing area, a call, and the other part the outside of a viewing area here. Usually, although the bus line made from the metallic material although a bus line and TFT were prepared in the part besides a viewing area has protection-from-light nature,

TFT makes light penetrate. Therefore, the protection-from-light member called a black matrix (BM) is prepared in the part between TFT and a cel electrode, and a bus line.
[0079] He prepares projection 20A in the part besides the viewing area on the opposite (common) electrode 12 of the CF substrate 16, and is trying to produce orientation restraining force in the 10th example in the different direction from the orientation restraining force by the slanting electric field produced with the edge of the pixel electrode 13. Since the condition at the time of no electrical-potential-difference impressing is shown and perpendicular orientation processing is performed, (1) of drawing 63 carries out orientation of the liquid crystal molecule 14 almost at right angles to the front face of electrodes 12 and 13 and projection 20A. If an electrical potential difference is impressed, as shown in (2) of drawing 63, orientation of the liquid crystal molecule 14 will be carried out in the direction which becomes perpendicular to electric field 8. Out of a viewing area, since there is no pixel electrode 13, it applies out of a viewing area near the edge of the pixel electrode 13, and electric field become slanting. Although it is going to carry out orientation of the liquid crystal molecule 14 in the different direction from the orientation in a viewing area for this slanting electric field as shown in (2) of drawing 58, as the orientation restraining force of projection 42 shows to (2) of drawing 63, orientation will be carried out in the same direction as the orientation in a viewing area.
[0080] Drawing 64 is drawing showing the projection pattern in the 10th example. Moreover, drawing 65 is drawing which expanded the part surrounded with the circle by drawing 64. In the 10th example, in order to realize basic arrangement of drawing 63 in the 9th example, the auxiliary projection is prepared. It is drawing showing the pattern of the projection train in the example applied to the method which establishes the projection train crooked in zigzag as a domain regulation means by VA method. As compared with drawing 59, the auxiliary projection 52 is newly provided near [where it gazed at the schlieren organization] the part so that clearly. This auxiliary projection 52 has led to projection train 20A prepared on a counterelectrode 12, and is formed in one. In the part which formed the auxiliary projection 52, relation shown in drawing 63 was realized, since the orientation of the liquid crystal molecule 14 in the edge part of a pixel electrode was in agreement with the orientation in a viewing area as shown in drawing 65, it did not gaze at the schlieren organization at which it gazed by drawing 59, but its display quality improved. In addition, drawing 258 shows the example which formed the auxiliary projection 52 in drawing 65 so that the edge of the pixel electrode 13 might be countered. In this case, it did not gaze at the schlieren organization.
[0081] In addition, in the 10th example, although acrylic transparence resin was used as a projection, it is also possible to use a black thing, and since the leakage light in a projection part can be intercepted if a black thing is used, contrast improves. Although drawing 63 and drawing 64 showed the example which forms the auxiliary projection 52 as a domain regulation means outside a field out of a viewing area, it is also possible to prepare a hollow (slot) instead of a projection. However, a hollow needs to prepare in a TFT substrate side.
[0082] As long as the domain regulation means outside a field has suitable orientation restraining force, what kind of thing is sufficient as it. For example, it is known that the direction of orientation will change specific wavelength, such as ultraviolet rays, at the orientation film if light is irradiated, and changing some directions of orientation besides a viewing area using this can also realize the domain regulation means outside a field. Drawing 66 is drawing explaining change of the direction of orientation by the exposure of ultraviolet rays. If the perpendicular orientation film is applied to a substrate side and the ultraviolet rays which are not polarized [a 45-degree direction to] are irradiated by a certain include angle and (2) from one direction there as shown in (1) of drawing 66, it is known that the direction of orientation of the liquid crystal molecule 14 will fall on the direction of radiation of ultraviolet rays from a perpendicular.
[0083] Drawing 67 is drawing showing the modification of the 10th example, and irradiated ultraviolet rays from the direction shown in the part 43 of the orientation film by the side of the TFT substrate which counters the auxiliary projection 52 as a domain regulation means outside a field shown in drawing 64 by the arrow head 54. Thereby, a part 53 comes to have the orientation restraining force committed in the direction which offsets the effect of the slanting electric field in the edge of the cel electrode 13. Therefore, the same effectiveness as the 10th example shown in drawing 64 is acquired. In addition, although ultraviolet rays were irradiated only at the TFT substrate side, you may make it irradiate the CF substrate 16 side in drawing 67 at both a chisel or a TFT substrate, and CF substrate. In addition, it is necessary to set up the direction of radiation of ultraviolet rays the optimal by the reinforcement of the orientation restraining force by exposure conditions, and balance with the orientation restraining force by slanting electric field.
[0084] the domain regulation means outside a field reduces the effect of the orientation on the liquid crystal

molecule in the viewing area of the slanting electric field produced with the edge of a cel electrode, and is stable in the orientation of the liquid crystal molecule in a viewing area -- since it prepares for last reason, it is applicable not only to VA method but other methods. Here, the desirable arrangement to the edge of the projection which works as a domain regulation means, and the pixel electrode 13 of a hollow is considered. Drawing 68 is drawing showing the example of the fundamental physical relationship of the projection which works as the edge and domain regulation means of a pixel electrode. As are shown in (1) of drawing 68, and projection 20B is arranged at the edge of the pixel electrode 13 or it is shown in (2) of drawing 68 As projection 20A is arranged at the part of the counterelectrode 12 which counters the edge of the pixel electrode 13 or it is shown in (3) of drawing 68 Projection 20B by the side of the TFT substrate 17 is arranged for projection 20A by the side of the CF substrate 16 out of a viewing area inside a viewing area to the edge of the pixel electrode 13.
[0085] A projection is arranged at the edge or the part which counters of the pixel electrode 13, and the field related to the direction of orientation of liquid crystal is divided by projection with an edge (1) of drawing 68, and (2). It stops therefore, affecting the orientation in a viewing area at all whatever the slanting electric field besides a viewing area. Therefore, within a viewing area, the stable orientation is obtained and display quality is improved.
[0086] According to the arrangement conditions of (3) of drawing 68, since the direction of the orientation restraining force by the slanting electric field in the edge of the pixel electrode 13 and the orientation restraining force by projection is in agreement, the orientation which did not generate the domain but was stabilized is obtained. In addition, the conditions which make in agreement the direction of the orientation restraining force by slanting electric field and the orientation restraining force by the domain regulation means can be realized also when using a hollow instead of a projection. Drawing 69 is drawing showing the edge at the time of realizing the arrangement conditions which are equivalent to (3) of drawing 68 in a hollow, and arrangement of a hollow. That is, hollow 23A by the side of the CF substrate 16 is arranged for hollow 23B by the side of the TFT substrate 17 out of a viewing area inside a viewing area to the edge of the pixel electrode 13.
[0087] Drawing 70 is LCD which established the straight-line-like (shape of stripe) projection train as a domain regulation means like the 1st example, is drawing showing the array of the projection train which realized the conditions of (3) of drawing 68, and shows a sectional view to (2) for the top view seen from the bottom to (1). With the configuration of drawing 70, the height of a projection was set to 40 micrometers, and after the width of face of about 2 micrometers and a projection stuck two substrates, it made the gap of 7 micrometers, a projection, and a projection the structure where the projection of a TFT substrate and the projection of CF substrate were arranged by turns. In addition, although a projection will be arranged between the pixel electrodes 13 in the TFT substrate 17 since the conditions of (3) of drawing 68 are realized, since the gate bus line 31 is formed between the pixel electrodes 13, the projection arranged between the pixel electrodes 13 will be located on the gate bus line 31.
[0088] In LCD of drawing 70, since a domain like before which is not desirable was not observed and did not have a part with a slow switching rate, either, the after-image etc. was not observed but good display quality was acquired. In addition, in drawing 70, if projection 20B arranged between the pixel electrodes 13 is arranged on the edge of the pixel electrode 13, the conditions of (1) of drawing 68 will be realized, and if Projections 20A and 20B are arranged to a reverse substrate by the arrangement, the conditions of (2) of drawing 68 will be realized. Although it may be arranged to the TFT substrate 17 side or may be arranged to the CF substrate 16 side, when a gap of the lamination of a substrate is taken into consideration, as for the projection arranged in the location which counters an edge top or an edge, it is desirable to form in the edge of the cel electrode 13 by the side of the TFT substrate 17.
[0089] Drawing 71 is the projection of another pattern configuration, is drawing showing the array of the projection train in LCD of the 11th example which realized the conditions of (3) of drawing 68, and shows a sectional view to (2) for the top view seen from the bottom to (1). Like illustration, the grid of a projection has been arranged like the squares between the cel electrodes 13, and sequential formation of the projection of this and an analog was further carried out toward the inside of each pixel. If such a projection pattern is used, the direction of orientation can be quadrisected in each pixel. However, the rate of each orientation direction cannot be made equal. Also in this case, a projection pattern in a grid pattern will be arranged on the gate bus line 31 and the data bus line 32 which were prepared between the cel electrodes 13.
[0090] In addition, also in drawing 71, if projection 20B arranged between the cel electrodes 13 is formed in the

part which counters the edge of the cel electrode 13 of the TFT substrate 17, or the edge of the CF substrate 16, (1) of drawing 68 and the conditions of (2) will be realized. It is desirable to form a projection in the edge of the cel electrode 13 by the side of the TFT substrate 17 also in this case. Although drawing 71 showed the example which also formed the projection in the shape of [rectangular] a grid according to the rectangular cel electrode, since a projection is a rectangle, the rate of each orientation direction cannot be made equal. Then, it is possible to use the projection train crooked in zigzag as shown in the 9th example. However, as drawing 59 and drawing 61 explained, unless a projection like drawing 64 is prepared, the domain which is not desirable occurs near the edge of the cel electrode 13. For this reason, it is possible to use not the projection that continued as shown in drawing 72 but the projection which became independent every pixel 13. However, since the abnormalities in orientation arise in the part shown by T of a pixel 13 and the distance from the electric-field control section (TFT) 33 differs when the projections 20A and 20B shown in drawing 72 are formed, the problem that a speed of response falls arises. It is the projection train crooked in zigzag to the rectangular pixel, and it is impossible to fill with all edges the arrangement conditions over the edge of the cel electrode of a projection shown in drawing 68. This problem is solved in the 12th example.

[0091] Drawing 73 is the pixel electrode 13 in the 12th example, the gate bus line 31, the data bus line 32, TFT33, and drawing showing the configuration of Projections 20A and 20B. Like illustration, it considered as the configuration where the pixel electrode 13 was also set by the configuration crooked in the zigzag of Projections 20A and 20B, in the 12th example. If it is this configuration, it does not generate, but since the distance from the electric-field control section 33 to the edge of the pixel electrode 13 is equal, the abnormalities in orientation can also improve a speed of response. In addition, the gate bus line 31 also makes zigzag crooked in the 12th example according to the configuration of the pixel electrode 13.

[0092] In addition, if the projection arranged on the gate bus line 31 is formed in the part which counters the edge of the pixel electrode 13, or the edge of the CF substrate 16, (1) of drawing 68 and the conditions of (2) will be realized. It is desirable to form a projection in the edge of the pixel electrode 13 by the side of the TFT substrate 17 also in this case. However, it is only an edge parallel to the gate bus line 31 that the conditions of drawing 68 are realized, and it is not satisfied about an edge parallel to the data bus line 32. Therefore, about this part, it will be influenced of slanting electric field and the problem explained by drawing 61 arises from drawing 58.

[0093] Drawing 74 is the pixel electrode 13 of the modification of the 12th example, the gate bus line 31, the data bus line 32, TFT33, and drawing showing the configuration of Projections 20A and 20B. Although it was made the configuration where the gate bus line 31 was also crooked in zigzag according to the configuration of the cel electrode 13 crooked in zigzag, in the 12th example of drawing 73, the gate bus line 31 can also be made to become the configuration where the data bus line 32 was crooked in zigzag in a straight line by the configuration of the cel electrode 13 being shown in drawing 74. In addition, in drawing 74, Projections 20A and 20B are projections which did not become independent for every pixel but continued over two or more pixels. Projection 20B is prepared on the data bus line 32 prepared in the vertical direction to the field between the cel electrodes 13, and the conditions of (3) of drawing 68 are realized. Also in arrangement of drawing 74, if the projection arranged on the data bus line 32 is formed in the part which counters the edge of the cel electrode 13, or the edge of the CF substrate 16, (1) of drawing 68 and the conditions of (2) will be realized. It is desirable to form a projection in the edge of the cel electrode 13 by the side of the TFT substrate 17 also in this case.

[0094] In addition, in arrangement of drawing 74, the projection is crossing the edge of the cel electrode 13 parallel to the gate bus line 31. Therefore, about this part, it will be influenced of slanting electric field and the problem explained by drawing 61 arises from drawing 58. Drawing 75 is drawing showing another modification of the 12th example. It is made for crookedness of a projection to produce twice the arrangement shown in drawing 75 within a pixel. Thereby, since the configuration of a pixel becomes close to a rectangle from drawing 74, a display becomes legible.

[0095] Drawing 76 is the cel electrode 13 of the 13th example, the gate bus line 31, the data bus line 32, TFT33, and drawing showing the configuration of Projections 20A and 20B, and drawing 77 is the A-A'cross-section and B-B' cross section shown in drawing 76. Although the domain regulation means outside a field was established out of the viewing area and the pixel electrode was made into the configuration crooked in zigzag in the 12th example in the 10th example in order to reduce the effect by the slanting electric field of the edge part of the pixel electrode 13 in the case of having the projection train crooked in zigzag, it is difficult to lose effect completely. Then, the part which orientation as shown in drawing 59 and drawing 61 is disturbed, and the

domain which is not desirable produces is shaded by the black matrix (BM) 34, and it is made not to influence a display in the 13th example.
[0096] Since the part of A-A' shown in drawing 76 is not influenced of slanting electric field, as it is shown in (1) of drawing 77 as usual, BM34 is narrowed, and since the effect of slanting electric field is large, the part of B-B' makes width of face of BM34 large compared with the former, and is made not to be displayed. If it is this, display quality will not deteriorate and the fall of an after-image or contrast will not be produced. However, since the area of BM34 increases, a numerical aperture decreases and the brightness of a display falls. However, it does not become a problem if the area which BM34 increases is not so large.
[0097] As mentioned above, if it is the 13th example, since the effect of the slanting charge in the edge part of a pixel electrode can be reduced from the 10th example, display quality improves. Although the orientation of liquid crystal is divided by establishing a domain regulation means in the example explained until now It will be divided into bearing in which 180 degrees of domains differ in the part of a domain regulation means if the orientation of the boundary part of a domain is observed in a detail. It turned out that the very small domain where 90-degree bearings differ exists in the boundary part between domains (on a projection, a hollow, or a slit), and the field which looks dark exists in the boundary (the edge of a projection near [If it is a projection]) of each domain also including a very small domain. Such a field that looks dark caused decline in a numerical aperture, and the display became dark and it had a problem of the end. As mentioned above, it is necessary to prepare CS electrode used as the factor which reduces a numerical aperture, to have established the black matrix (BM) which otherwise shades the perimeter of a TFT part or a display pixel electrode, and to make it not cause decline in a numerical aperture as much as possible in the liquid crystal display using TFT.
[0098] Although it already explained that the auxiliary capacity (Storage Capacitor) by CS electrode was used, an operation and electrode structure of auxiliary capacity are explained briefly here. (1) of drawing 78 is drawing showing the circuit for every pixel in the liquid crystal panel which has auxiliary capacity. As shown in drawing 17, the CS electrode 35 is formed in parallel with the cel electrode 13 so that a capacitative element may be constituted through a dielectric layer between the cel electrodes 13. Since the CS electrode 35 is connected to the same potential as the common electrode 12, as shown in (1) of drawing 78, the auxiliary capacity 2 is formed in the capacity 1 and juxtaposition by liquid crystal. When impression of the electrical potential difference to liquid crystal 1 is performed, impression of an electrical potential difference is similarly performed in the auxiliary capacity 2, and the electrical potential difference held at liquid crystal 1 is held also by the auxiliary capacity 2. Since the auxiliary capacity 2 cannot be easily influenced of electrical-potential-difference change, such as a bus line, compared with liquid crystal 1, it controls an after-image and a flicker and there is effectiveness in control of the poor display by the TFT OFF state current etc. In forming the CS electrode 35, in order to make a process simple, it is desirable to form in the same layer as the gate (gate bus line) which constitutes a TFT component, the source (data bus line), or a drain (cel) electrode with the same ingredient. Since these electrodes are formed with an opaque metal from the relation of precision, its CS electrode 35 is also opaque. As mentioned above, since CS electrode is formed in parallel with the cel electrode 13, the part of CS electrode cannot be used as a display pixel, but the part numerical aperture falls.
[0099] While low-power-ization is advanced, as for the liquid crystal display, improvement in display brightness is demanded. Therefore, the thing of a numerical aperture high as much as possible is desirable. On the other hand, in order that the leakage light of these parts may reduce display quality, if a protection-from-light ingredient is used for a projection or it is a slit, shading by BM etc. is desirable [as explained until now, a slit is prepared in a projection or an electrode for improvement in display quality, but]. However, this becomes the factor which reduces a numerical aperture. Therefore, it is desirable by piling these up as much as possible to prevent decline in a numerical aperture as much as possible.
[0100] (2) of drawing 78 is an example of arrangement of the CS electrode 35 and Projections 20A and 20B considered when arranging much projections of narrow width of face. Although it is prepared so that Projections 20A and 20B may lap with some CS electrodes 35, the part with which the direction of the CS electrode 35 does not lap since width of face is wide also exists. Drawing 79 is drawing showing arrangement of the projection 20 (20A, 20B) in the 14th example, and the CS electrode 35, (1) shows a plan and (2) shows a sectional view. Like illustration, the CS electrode 35 is divided and is prepared in the bottom of Projections 20A and 20B. In order to realize auxiliary capacity of a predetermined capacity, a predetermined area is required for the CS electrode 35. If each CS electrode 35 divided into five of drawing 79 is set, it will become the same area as the CS electrode 35 shown in (2) of drawing 78. And in drawing 79, since the CS electrode 35 and

Projections 20A and 20B have lapped altogether, the decline in a numerical aperture is only a fallen part by CS electrode substantially. Therefore, even if it prepares a projection, a numerical aperture will not fall. Arrangement of the 14th example is applicable if it is the configuration which uses a projection as a domain regulation means.

[0101] Drawing 80 is drawing showing the slit 21 of electrodes 12 and 13 and the arrangement of the CS electrode 35 in the modification of the 14th example, (1) shows a plan and (2) shows a sectional view. Although a slit 21 works as a domain regulation means, since the part produces leakage light, shading is desirable. Here, like the 14th example, the CS electrode 35 is divided, each is arranged into the part of a slit 21, and leakage light is shaded. In addition, since the area of the sum total of the CS electrode 35 is the same, there is no decline in a numerical aperture.

[0102] Drawing 81 is drawing showing the slit 21 of electrodes 12 and 13 and the arrangement of the CS electrode 35 in the modification of the 14th example, (1) shows a plan and (2) shows a sectional view. Except that the projection is crooked in zigzag, it is the same as drawing 79. Drawing 82 is drawing showing the slit 21 of electrodes 12 and 13 and the arrangement of the CS electrode 35 in the modification of the 14th example, (1) shows a plan and (2) shows a sectional view. By the case where the area of the sum total of Projections 20A and 20B of this modification is larger than the area of the CS electrode 35, the CS electrode 35 is formed corresponding to the edge section of Projections 20A and 20B, and CS electrode is not prepared in the center section of the projection. The very small domain where 90-degree azimuths which exist near the summit of a projection differ by this can be utilized effective in a display, and a brighter display is obtained.

[0103] The configuration which divides the CS electrode 35 and is arranged into the part of a domain regulation means is applicable also to the configuration which uses a hollow as a domain regulation means. In the 14th example explained above, decline in the numerical aperture at the time of using a domain regulation means can be prevented. Drawing 83 is drawing showing the projection pattern of the 15th example. In the 15th example, when the straight-line-like projections 20A and 20B are arranged in parallel to the up-and-down substrate, respectively and it sees from the front face of a substrate, it arranges so that these projections 20A and 20B may intersect a right angle mutually. In the condition of not impressing an electrical potential difference to inter-electrode, although orientation of the liquid crystal molecule 14 is perpendicularly carried out to a substrate front face, orientation of the liquid crystal molecule near the slant face of Projections 20A and 20B is carried out at right angles to a slant face. Therefore, the liquid crystal molecule near the slant face of Projections 20A and 20B inclines in this condition, and, moreover, the directions of an inclination differ 90 degrees near projection 20A and near projection 20B. If an electrical potential difference is impressed to inter-electrode, a liquid crystal molecule will incline in the direction which becomes parallel to a substrate, but since it is regulated in the direction which is [near projection 20A and near projection 20B] different 90 degrees, it is twisted (it twists). Change of the image at the time of [in the 15th example] twisting is the same as TN mold shown in drawing 2, the time of no electrical-potential-difference impressing is in the condition shown in (3) of drawing 2, and it differs in that the time of electrical-potential-difference impression will be in the condition which shows in (1). Moreover, as shown in drawing 83, in the 15th example, four different twist fields are formed within limits surrounded by Projections 20A and 20B. Therefore, a viewing-angle property is also good. In addition, the directions of the twist differ in an adjoining field.

[0104] Drawing 84 is drawing explaining why the speed of response in the 15th example becomes quicker than the speed of response in the 1st example. (1) of drawing 84 shows the condition of not impressing an electrical potential difference, and it is carrying out orientation of the liquid crystal molecule at right angles to a substrate. If an electrical potential difference is impressed, as shown in (2), by LCD of the 15th example, it will incline so that it may twist. On the other hand, in LCD of the 1st example, as shown in (3), the liquid crystal molecule of other parts carries out orientation by making into a trigger the liquid crystal molecule which is in contact with the projection, but since it is not regulated, the liquid crystal near the center of an up-and-down projection carries out orientation of the orientation in the same direction, as shown in (4), after it flusters at the time of change **** and between a certain degree degree hours passes. Change which not only LCD of VA method which used the projection but LCD generally twists is high-speed, and a speed of response becomes [the direction of the 15th example] a high speed from the 1st example.

[0105] Drawing 85 is drawing showing the viewing-angle property of LCD of the 15th example. Even if the viewing-angle property is very good like LCD of VA method of the 1st example, and is better than TN method, of course and it compares it with an IPS method, it is more than an EQC. (1) of drawing 86 is drawing showing

the speed of response in change between 16 gradation eye, 32 gradation eyes, 48 gradation eyes, 64 gradation eyes, and black (1 gradation eye) in the case of performing 64 gradation displays by LCD of the 15th example. The speed of response of the multi-domain VA method which used the parallel projection of the 1st example for (1) of drawing 87 for the speed of response of the mono-domain VA method which does not divide orientation into (2) of drawing 86 for the speed of response of TN method as reference is shown in (2) of drawing 87. For example, the speed of response from all black to all whites is 19ms in the 15th example to being 19ms by 19ms and the multi-domain VA method in TN method, and is the same level as other VA methods in 58ms and a mono-domain VA method. Even if it measures the speed of response from all whites to all black against VA method of the 6ms and others in the 15th example to being 12ms in 21ms and a mono-domain VA method by 12ms and the multi-domain VA method, it is good in TN method. Furthermore, for 30ms, the speed of response from all black to 16 gradation eye is 28ms in the 15th example to being 130ms in 50ms and a multi-domain VA method, is the same level as TN method in a mono-domain VA method, and is farther [than other VA methods] good in TN method. By 21ms and the mono-domain VA method, the speed of response from 16 gradation eye to all black was 4ms in the 15th example to being 18ms in 9ms and a multi-domain VA method, and was better than any of other methods in TN method. In addition, about the IPS method, the speed of response was very slow compared with other methods, and the speed of response from all black to all whites and the speed of response from all whites to all black was [the speed of response from 16 gradation eye to all black of the speed of response from all black to 16 gradation eye] 75ms for 200ms for 75ms.
[0106] Thus, a viewing-angle property and the speed of response of LCD of the 15th example are very good. Drawing 88 is drawing showing other projection patterns which realize VA method of the above twist molds. In (1) of drawing 88, it is intermittent so that it may extend in each substrate and it may not be intersected at a right-angled 2-way, Projections 20A and 20B are formed, and two substrates are arranged so that it may cross, when each projection sees from a substrate. In this example, four twist fields are formed in a different form from drawing 83. In each twist field, the direction of the twist is the same and the rotation location has shifted by a unit of 90 degrees. Moreover, in (2) of drawing 88, it extends in a 2-way right-angled to each substrate, and the projections 20A and 20B which cross mutually are formed, and it shifts and arranges in both directions. In this example, two twist fields where the twist directions differ are formed.
[0107] In drawing 83 and drawing 88, the projections 20A and 20B prepared in two substrates do not need to cross so that it may intersect perpendicularly. Drawing 89 shows the example arranged so that the projections 20A and 20B of drawing 83 may cross include angles other than 90 degrees. Although four twist fields where the twist directions differ also in this case are formed, the amounts of twists will differ in two fields which counter.
[0108] Furthermore, the same result was obtained even if it prepared the slit instead of the projections 20A and 20B shown by drawing 83, drawing 88, and drawing 89. By the frame surrounded by Projections 20A and 20B, [near the projection], there is nothing that controls orientation, and since it is far from a projection, orientation turbulence-comes to be easy in the center section with the 15th example of drawing 83. For this reason, since orientation is stabilized, time amount is taken, and it is expected that the speed of response of a center section becomes slow. Since it is strongly influenced of the projection used as two adjacent sides, the amount of [of a frame] corner of a response is the quickest. The effect of the orientation in the part of this angle collides [then / propagation and /,] with the effect of other twist fields in the center section, a field is decided, and it is stabilized. Thus, since all liquid crystal does not carry out orientation to coincidence at the time of electrical-potential-difference impression, a certain part carries out orientation previously and it gets across to the perimeter, in the center section distant from the projection, a speed of response becomes slow. Moreover, when it crosses like drawing 83 for example, and the frame to make serves as a square, it is transmitted from four corners, but when the frame which crosses like drawing 89 and is made is a parallelogram, it is transmitted from the acute-angle part to which the effect of a projection becomes strong more to a center section, and effect collides in the center section and it gets across to the angle of an obtuse angle part further. For this reason, a speed of response becomes [the direction in case a frame is a parallelogram from a square] slow. In order to solve such a problem, as shown in drawing 90, projection 20D [**** / a frame] is prepared in the center section of the frame. For example, things and a good speed of response were obtained as Projections 20A and 20B made projection 20D the square drill of the square whose base is 5 micrometers by setting width of face to 5 micrometers, and setting spacing of 1.5 micrometers and a projection to 25 micrometers for height.
[0109] Drawing 91 is the example which prepared the projection in the core of the frame of the projection

pattern of drawing 89. Thereby, the same result as drawing 83 was obtained. In the configuration which the projections 20A and 20B shown by drawing 83, drawing 88, and drawing 89 intersect, if it is made for the sum of the height of Projections 20A and 20B to become equal to spacing of a substrate, i.e., the thickness of a liquid crystal layer, the thickness of a liquid crystal layer can be specified in the part which Projections 20A and 20B intersect. It becomes unnecessary thereby, to use a spacer.

[0110] Drawing 92 is drawing showing the panel structure in the 16th example, and (1) shows the perspective view of the part in which (2) is equivalent to one grid in a side elevation. Moreover, drawing 93 is drawing which looked at the projection pattern in the 16th example from the direction perpendicular to a panel. Like illustration, in the 16th example, projection 20A is formed in the shape of [which crossed on the electrode 12 prepared on one substrate] a matrix, and square drill-like projection 20B is formed in the location equivalent to the center position of the grid which counters on the electrode of the substrate of another side. In the field shown in (2) of drawing 92, by the principle shown in (2) of drawing 12, orientation is divided and, moreover, it is divided equally [four directions]. In the result made [an inter-electrode distance (thickness of a liquid crystal layer)] the height of a projection for spacing of the longitudinal direction of Projections 20A and 20B as an experiment by 5 micrometers to 3.5 micrometers at 10 micrometers, the viewing-angle property was comparable as the thing of the 1st example shown in drawing 22 in fact.

[0111] Drawing 257 is drawing showing the modification of the 16th example, (1) shows a projection pattern and (2) shows a sectional view. This modification makes reverse arrangement of the projection of the shape of a matrix of the 16th example, and a square drill-like projection. That is, projection 20A arranged on the electrode 12 of the CF substrate 16 is made into the shape of a square drill, and projection 20B by the side of the TFT substrate 17 is made into the crossing shape of a two-dimensional matrix. Projection 20A is arranged at the core of a pixel 9, and projection 20B considers as the same pitch as a pixel array, and is arranged on the bus line between pixels 9. Therefore, orientation of the liquid crystal is carried out in the four directions into each pixel. As shown in (2) of drawing 257, a domain is divided by projection 20A in the center of a pixel. Moreover, arranged projection 20B divides orientation into the outside of the pixel electrode 13 like illustration on the boundary of a pixel. Furthermore, in this part, the edge of a pixel electrode works as a domain regulation means. Since the orientation restraining force and the orientation restraining force of the edge of a pixel electrode by projection 20B are in agreement, stable orientation division can be performed. In this modification, since distance with the edge of projection 20A, projection 20B, and the pixel electrode 13 is long, a speed of response falls a little, but since it is only projection 20A, that it is in a pixel has a small area which a projection occupies within a pixel, and it can make display brightness high. Furthermore, if projection 20B is formed with the formation process of a bus line, since a process will not increase, a manufacturing cost can be reduced.

[0112] The projection manufactured in the 16th example by the resist which is an insulating material as a domain regulation means to divide the orientation of liquid crystal is used from the 1st example explained above, and the configuration of the slant face of a projection is mainly used in these examples. However, an electric-field shielding effect is also very important for an insulating projection. Although the drive of liquid crystal is generally performed by the alternating current wave form, it is necessary with an improvement of the speed of response in a liquid crystal ingredient side to fully take into consideration about effect within one frame (for a direct current to be impressed), i.e., the effect by the direct current wave. Therefore, there is the 2nd page, an alternating current property and a direct-current property, in the drive wave of liquid crystal, and it must be satisfied with it of both requirements. Then, the above-mentioned resist arranged since it has effect of request of reducing electric field on the drive property of this liquid crystal needs to be set as predetermined conditions in the both sides of an alternating current property and a direct-current property. Specifically, a resist needs to be set up so that electric field may be reduced also as a direct-current property also as an alternating current property.

[0113] First, it needs to be high to extent which specific resistance rho affects from a viewpoint of a direct-current property to resistance of a liquid crystal layer. That is, in order to be set as the specific resistance (the liquid crystal for for example, a TFT drive is a value about 1012ohmcm or beyond it) of liquid crystal, and the value more than an EQC, the value more than 1012-ohmcm is required, and it is still more desirable if it is more than 1013-ohmcm. Next, in order for a resist to have the operation which reduces the electric field of the liquid crystal layer [directly under] of it from a viewpoint of an alternating current property, it is required for the electric capacity value (value decided by the dielectric constant epsilon, thickness, and the cross-sectional area) to be about 10 or less-time value (about [as an impedance] 1/10 or more values) compared with the electric

capacity value of the liquid crystal layer under the resist. For example, since a dielectric constant epsilon is about 3, a resist is about 1 of dielectric constant epsilon of liquid crystal layer (about 10)/3, and when thickness is about 0.1 micrometers, it is about 1 of thickness (for example, about 3.5 micrometers) of liquid crystal layer/35. In this case, the capacity value of an insulator layer will be about 10 times the capacity value of the liquid crystal layer under an insulator layer. That is, since the impedance serves as a value of the abbreviation 1/10 of the impedance of the liquid crystal layer [directly under] of it, a resist (insulator layer) can affect electric-field distribution of a liquid crystal layer.

[0114] Therefore, in addition to the size effect by the slant face of a resist, the effect by electric-field distribution is obtained, and the firm orientation stabilized more is obtained. Although a liquid crystal molecule inclines if an electrical potential difference is impressed, the inside of an orientation division field (on a resist) is fully the electric field of low strength, and in this, the liquid crystal molecule which carries out orientation almost perpendicularly exists in stability, and acts as an obstruction (separation wall) of a domain generated on those both sides. And if a still higher electrical potential difference is impressed, the liquid crystal in a division field (on a resist) also begins to incline shortly. However, the domain previously formed in both the sides of a resist inclines in the direction almost level to a resist shortly. (Very firm orientation is obtained.) In order to acquire this condition, the insulating layer (resist) of a division field needs to have about 10 or less times [of the liquid crystal layer / directly under / of it] capacity value. That is, a dielectric constant epsilon is good and the thicker thing of thickness is [a small ingredient] better [a dielectric constant]. Although the dielectric constant epsilon shows that the insulator layer of thickness 0.1 micrometers or more is good by about 3, if the insulator layer which has the still smaller dielectric constant epsilon and still thicker thickness is used, much more desirable operation and effectiveness can be acquired. Although the dielectric constant epsilon prepared the projection of 1.5 micrometers of thickness by the novolak system resist of 3 in the 16th example from the 1st example and being observed about the orientation division situation, the orientation stabilized very much was obtained. Since the resist of a novolak system is widely used by the production process of TFT or CF, it has a big merit (extension of a facility is unnecessary **) on the occasion of application.

[0115] Moreover, even if compared with other resists and flush-ized material, it checked that high dependability was acquired and it was satisfactory. Moreover, still more desirable operation and effectiveness can be acquired by using such an insulator layer for the substrate of both sides. In addition, the same result was obtained although the acrylic resist (epsilon= 3.2) also checked effectiveness as an insulator layer besides the above-mentioned novolak system resist.

[0116] Although the slit section is prepared in an electrode, or the projection of an insulator is formed on an electrode and the orientation of a liquid crystal molecule was divided in the 1st to 16th example, it is also possible to make it other forms and some of those examples are shown below. Drawing 94 is drawing showing the panel structure of the 17th example, (1) is a perspective view and (2) is a side elevation. Like illustration, in the 17th example, the projection 50 prolonged in parallel with an one direction is formed on glass substrates 16 and 17, and electrodes 12 and 13 are formed on it. Half-pitch gap ****** of the projection 50 is carried out. Therefore, electrodes 12 and 13 become the configuration where the part projected. Perpendicular orientation processing is performed on an electrode. Although electric field will become perpendicularly if an electrical potential difference is impressed to inter-electrode when the electrode of such a configuration is used, the direction of orientation is divided into a 2-way bordering on a height. Therefore, conventionally, a viewing-angle property improves. However, unlike the case where a projection is an insulating material, electric-field distribution will divide orientation according to the effectiveness of only a configuration. Therefore, the stability of orientation is a little inferior compared with the projection of an insulator. However, the projection prepared on an electrode as mentioned above has constraint that it is necessary to use the insulating material of a low dielectric constant, and the ingredient which can be used has constraint. Furthermore, various kinds of conditions needed to be filled with such an ingredient to form a projection, and after that a process was simplified, there was a problem. On the other hand, if it is the panel structure of the 17th example, there is an advantage that there is such no constraint.

[0117] Drawing 95 is drawing showing the panel structure of the 18th example. This example is what established the slot in the insulating layer 51 prepared on the ITO electrodes 12 and 13 as a domain regulation means, and the configuration of a slot can apply the configuration of the projection and electrode slit which were shown in the 9th example from the 2nd example. In this case, the effectiveness by the above-mentioned slanting electric field acts in the direction which stabilizes orientation like the case of a projection.

[0118] Drawing 96 is drawing showing the panel structure of the 19th example. Like illustration, in this example, electrodes 12 and 13 were formed on glass substrates 16 and 17, respectively, the layer 62 which has the slots 23A and 23B with a depth of 1.5 micrometers by width of face of 10 micrometers with a conductor ingredient on it was formed, and the perpendicular orientation film 22 was formed on it. In addition, the thickness of a liquid crystal layer is 3.5 micrometers, and illustration of the color filter layer 39, a bus line, TFT, etc., etc. is omitted. It was observed that the orientation of liquid crystal is divided in the part of a hollow. That is, it checked that a hollow also acted as a domain regulation means.
[0119] the panel structure of the 19th example -- the case of a projection -- the same -- a substrate -- becoming depressed -- 23A and 23B -- the same predetermined pitch 40micrometer -- arranging -- the hollows 23A and 23B of the upper bottom -- half-pitch ****** -- since it arranges like, the field which becomes the orientation same between the hollows of the adjoining upper and lower sides is formed. Drawing 97 is drawing showing the panel structure of the 20th example. In the 20th example, the layer 62 which has the slots 23A and 23B with a depth of 1.5 micrometers by width of face of 10 micrometers using color filter (CF) resin, respectively was formed on glass substrates 16 and 17, electrodes 12 and 13 were formed on it, and the perpendicular orientation film was formed further. That is, some electrodes 12 and 13 have become depressed. and Projections 23A and 23B are arranged by the same predetermined pitch 40micrometer -- having -- the hollows 23A and 23B of the upper bottom -- half-pitch ****** -- it is arranged like. Also in this case, the same result as the 19th example was obtained. In addition, in the 20th example, since the structure which has a hollow is prepared in the bottom of an electrode, there is little constraint about an ingredient and the ingredient used in other parts, such as CF resin, can be used.
[0120] In the case of a projection and a slit, orientation is divided so that a liquid crystal molecule may spread to hard flow in the part, but orientation is divided so that a liquid crystal molecule may face each other in the part in the case of a hollow. That is, an operation of orientation division of a hollow has a relation contrary to a projection and it of a slit. Therefore, in using it combining a hollow, a projection, or a slit as a domain regulation means, an old example differs from desirable arrangement. The arrangement in the case of using a hollow as a domain regulation means is explained.
[0121] Drawing 98 is drawing showing one of the desirable examples of arrangement at the time of combining a hollow and a slit. Slits 21A and 21B are arranged in the location which counters like illustration the hollows 23A and 23B of the 20th example shown in drawing 97. Since the direction of orientation division of the liquid crystal by the hollow and slit which counter is the same, orientation is stabilized more. For example, when a hollow was formed on condition that the 20th example, width of face of a slit was set to 15 micrometers and spacing of a hollow and the core of a slit was set to 20 micrometers, the switching time was 25ms on the drive conditions of 0-5V, and was 40ms on the drive conditions of 0-3V. On the other hand, when only a slit was used, they were 50ms and 80ms, respectively.
[0122] Drawing 99 is a thing except hollow 20A and slit 21A by the side of one substrate (in this case, substrate 16) in the panel structure of drawing 98, and the field of the direction of orientation same between adjoining hollow 20B and slit 21B is formed. In addition, in the panel structure of drawing 98 and drawing 99, even if it prepares a projection in the same location instead of a slit, the same property is acquired, and a speed of response improves further.
[0123] It becomes depressed in the electrode 13 of one substrate 17, 23B is prepared, and drawing 100 is arranged by turns in the location which becomes depressed about projection 20A and slit 21A in the substrate 16 which counters, and counters 23B at it. In this case, since it becomes depressed with adjoining hollow 23B and the group of projection 20A and the directions of orientation differ in the group of 23B and slit 21A, the boundary of the field of orientation is generated near the center of a hollow.
[0124] Drawing 101 is drawing showing the panel structure of the 21st example. The 21st example is an example which applied the configuration which establishes a hollow in the electrode of the 19th example to LCD of a passive-matrix mold. Also in this case, a part of front face of electrodes 12 and 13 has become depressed, and the direction of orientation is divided bordering on the part of a hollow. As mentioned above, an operation of orientation division of a hollow has a relation contrary to a projection and it of a slit. Even if there is an assembly error, it can avoid changing the rate of orientation division using this relation. First, the assembly error in the panel structure of the 21st example is explained.
[0125] Drawing 102 is a panel cross section at the time of preparing a projection in both substrates as a domain regulation means. As explained until now, the field where orientation is regulated by projection 20A prepared

on the common electrode 12 and projection 20B prepared on the cel electrode 13 is specified. In (1) of drawing 102, the field to which the field specified in the inclined plane on the right-hand side of projection 20B and the inclined plane on the left-hand side of projection 20A is specified in the inclined plane on the right-hand side of A, and the inclined plane on the left-hand side of projection 20B and projection 20A is set to B.

[0126] Here, according to an assembly error, as shown in (2) of drawing 102, supposing the CF substrate 16 shifts to left-hand side to the TFT substrate 17, Fields A will decrease in number and Field B will increase. Therefore, since the rate of the liquid crystal molecule by which stops being 1 to 1 and orientation division is carried out becomes less equal [the ratio of Field A and Field B], a viewing-angle property deteriorates. Drawing 103 is drawing showing the panel cross section of the 22nd example. In the 22nd example, as shown in (1) of drawing 103, it becomes depressed in the TFT substrate 17, and 22B and projection 20B are prepared, then, it becomes depressed in the CF substrate 16, 20A and projection 22A are prepared, and this is repeated. Field A' specified by projection 20B and projection 20A when the CF substrate 16 shifts to the TFT substrate 17 at the time of an assembly, as shown in (2) of drawing 103 Although it decreases, since field A" which becomes depressed with hollow 22B and is specified by 22A increases only a decrement, Field A does not change. Although it becomes depressed with projection 20B, it becomes depressed with 22B and projection 20A and it is prescribed by 22A, since this spacing does not change, Field B of Field B is fixed. Therefore, the ratio of Field A and Field B is fixed, and a viewing-angle property is maintained while it has been good.

[0127] Drawing 104 is drawing showing the panel cross section of the 23rd example. In the 23rd example, like illustration, it becomes depressed with projection 22A in the CF substrate 16, 20A is prepared by turns, and this is repeated. Field A becomes depressed with the inclined plane on the left-hand side of projection 20A, and is prescribed by the inclined plane on the right-hand side of 22A, and Field B becomes depressed with the inclined plane on the right-hand side of projection 20A, and is prescribed by the inclined plane on the left-hand side of 22A. Therefore, since the field of orientation is prescribed by only the projection and hollow which were established in one substrate, the precision of an assembly does not influence.

[0128] The example explained until now is an example aiming at a big angle of visibility being obtained covering all the directions. However, depending on the application of a liquid crystal panel, a big angle of visibility is just obtained in the case where an angle of visibility does not necessarily need to be large, and the specific bearing. By using the technique of the orientation division by the domain regulation means explained until now, LCD suitable for such an application is realizable. Next, the example which applied the technique of this invention to LCD of such a particular application is explained.

[0129] Drawing 105 is drawing showing the panel structure of the 24th example, (1) shows a plan and (2) shows the sectional view of Y-Y' of (1). Like illustration, the straight-line-like projections 20A and 20B are formed in substrates 16 and 17 in the same pitch, respectively, and from the location which counters, Projections 20A and 20B are shifted a little, and are arranged. In other words, it is the structure shown in drawing 102, and the field of B is made very narrow and almost is made into the field of A.

[0130] The panel of the 24th example is used for example, for the projection mold LCD. The viewing-angle property of the projection mold LCD may be narrow, its speed of response is quick, and to be high brightness by high contrast is demanded. the direction of orientation of the panel of the 24th example is an one direction substantially (mono-domain) -- it is -- a sake -- a viewing-angle property -- the former -- it is the same as VA method, and cannot be said as fitness. However, since Projections 20A and 20B are formed, a speed of response improves very much like LCD of an example explained until now compared with the conventional thing. Moreover, about contrast, since the thing of the same level as other VA methods is obtained, compared with conventional TN method and a conventional IPS method, it is good. As drawing 27 explained, since orientation is in disorder and leakage light penetrates, in order to make contrast high, as for the part of Projections 20A and 20B, it is desirable to shade the part of Projections 20A and 20B. On the other hand, about brightness, it is desirable to make the numerical aperture of the pixel electrode 13 high. Then, as shown in drawing 105, Projections 20A and 20B are formed in the edge section of the pixel electrode 13. Thereby, it becomes high brightness, without Projections 20A and 20B reducing a numerical aperture.

[0131] From the point of a speed of response, although it is desirable to narrow spacing of Projections 20A and 20B, it is necessary to arrange Projections 20A and 20B in the range of the pixel electrode 13 for that purpose. If Projections 20A and 20B are formed in the range of the pixel electrode 13, it is necessary to shade the part and the part numerical aperture will fall. Thus, a speed of response, contrast, and brightness have the relation of a trade-off, and it is necessary to set them up suitably according to the purpose of use etc.

[0132] Drawing 106 is drawing showing the structure where the viewing-angle property of three directions realizes the good LCD panel using the technique which forms the mono-domain of the 24th example. With this structure, Projections 20A and 20B are formed so that the field of the same orientation of two longitudinal directions of a rate and the field of the orientation of one lengthwise direction may be formed in one pixel. As the field of the same orientation of two longitudinal directions of a rate is shown in drawing 102, it is formed by half-pitch ** carrying out Projections 20A and 20B, and arranging them, and the field of the orientation of one lengthwise direction is formed by approaching and arranging Projections 20A and 20B, as shown in drawing 105. Thereby, although right and left and a lower viewing-angle property are good, the panel in which an upper viewing-angle property is inferior to other directions is realized.
[0133] LCD like the 24th example is prepared in high locations prepared on the door of an electric car, such as a display, and is used for the display arranged so that many men may look up from the bottom. As shown in drawing 87, LCD of VA method which performs orientation division by LCD of VA method, a projection, etc. which do not perform orientation division cannot say that the speed of response between halftone is enough, although the speed of response from white or white to [from black] black is good compared with TN method etc. Such a point is improved in the 25th example.
[0134] Drawing 107 is drawing showing the panel structure in the 25th example, (1) shows the configuration of the projection seen from the panel side, and (2) is a sectional view. The part from which the location of projection 20B is changed and spacing with projection 20A differs within one pixel like illustration is prepared. Therefore, the rate of the domain by which orientation is carried out to a 2-way is made equally, and the viewing-angle property is symmetrical. By making it structure like illustration, it seems that the speed of response between halftone has improved. This principle is explained with reference to drawing 111 from drawing 108.
[0135] Drawing 108 is drawing showing the structure of the panel manufactured in order to measure change of the speed of response by projection spacing, and permeability. The height of Projections 20A and 20B is 1.5 micrometers, width of face is 10 micrometers, and the thickness of a liquid crystal layer is 3.5 micrometers. The speed of response and permeability of the field of a gap d1 when setting one gap d1 of a projection to 20 micrometers, changing the gap d2 of another side, and changing the electrical potential difference impressed to inter-electrode between [equivalent to halftone] 0V and 3V and the field of d2 were measured.
[0136] Drawing 109 is a graph which shows the result of the speed of response measured as mentioned above. This graph is equivalent to what extracted the object part shown in drawing 20. It turns out that the response time falls as a gap d2 becomes narrow so that clearly from drawing. (1) of drawing 110 shows change of the permeability when changing applied voltage by making a gap d2 into a parameter. (2) of drawing 110 shows change of the permeability when changing the electrical potential difference which made the gap d2 the parameter to 3V from 0V. From drawing 110, by making the gap d2 of a projection small shows that the speed of response of halftone is improved sharply. However, the maximum permeability falls by making the gap d2 of a projection small. (1) of drawing 111 -- every -- it is the graph which normalized and showed time amount change of the permeability of d2, and (2) is drawing explaining orientation change of liquid crystal. As shown in (1) of drawing 111, when it makes time amount until permeability reaches 90% of the maximum permeability into the ON response time and the ON response time in case Ton2 and d2 are 30 micrometers about the ON response time in case Ton1 and d2 are 20 micrometers about the ON response time in case d2 is 10 micrometers is set to Ton3, it is the order of Ton1<Ton2<Ton3. As shown in (2) of drawing 111, at the time of no electrical-potential-difference impressing, only the liquid crystal near the projection is carrying out orientation of producing such a difference at right angles to the slant face of a projection, and orientation of the liquid crystal which is separated from a projection is carried out at right angles to an electrode. Although liquid crystal will incline if an electrical potential difference is impressed, to which direction it inclines can take the direction of 360 degrees to a shaft perpendicular to an electrode. Orientation of the liquid crystal near the projection is carried out so that orientation may be carried out at the time of no electrical-potential-difference impressing and the liquid crystal between projections may meet it by making this into a trigger. Thus, the domain which carries out orientation is formed in the same direction. Therefore, orientation is carried out to a high speed, so that it is close to a projection.
[0137] As mentioned above, the response time between black and white is fully short at LCD of the present VA method, and it is the response time in halftone that a speed of response becomes a problem. In the case of structure as shown in drawing 107, the permeability in the narrow field of gap d2" changes for a short time, and

the permeability in the large field of gap d2' changes slowly. although the field of gap d2" is narrower than the field of gap d2' and the rate which contributes to permeability is small -- human being's eyes -- a logarithm -- since it has a property [-like] -- gap d2' -- even if the permeability in the narrow field of 'changes for a while, it catches as a comparatively big change. Therefore, if the permeability in the narrow field of gap d2" changes for a short time, it will be sensed that it changed rapidly as a whole.

[0138] As mentioned above, if it is the panel of the 25th example, it seems that the speed of response between halftone has improved, without reducing permeability. Drawing 112 is drawing showing the panel structure of the 26th example. Although it prepares in substrates 16 and 17 in pitches [Projections / 20A and 20B] and electrodes 12 and 13 are formed on it in the 26th example like illustration, it is made not to form an electrode in one slant face of Projections 20A and 20B, and the perpendicular orientation film is formed further. And it arranges so that the slant faces in which the electrode is not formed may adjoin the slant face in which the electrode of Projections 20A and 20B is formed. In the field between the slant faces in which the electrode is not formed, orientation of the liquid crystal is carried out at right angles to this slant face, and, thereby, the direction of orientation is determined. In addition, since a broken line shows the electric field in a liquid crystal layer all over drawing and orientation of the liquid crystal is carried out in accordance with electric field, the direction of orientation by the electric field near [in which the electrode is not formed] a slant face is in agreement with the direction of orientation by the slant face.

[0139] On the other hand, between the slant faces in which the electrode is formed, although orientation of the liquid crystal near a slant face is perpendicularly carried out to the slant face, the direction of orientation of the electric field in this field differs from the direction of orientation by the slant face. Therefore, if an electrical potential difference is impressed, except for near a slant face, orientation of the liquid crystal of this field will be carried out in accordance with electric field. Thereby, the direction of orientation in two fields becomes equal, and mono-domain orientation is obtained.

[0140] It has a negative refractive-index anisotropy on the panel of the 26th example, and the viewing-angle property about contrast when a retardation piles up the same phase contrast film as the retardation of a liquid crystal panel is shown in drawing 113. High contrast was acquired covering the large angle of visibility. In addition, when this panel was built into a projection mold projector, it became 300 or more contrast ratios. In addition, the contrast ratio obtained when LCD of the usual TN method is included in a projection mold projector is about 100, and it turns out that it has been improved sharply.

[0141] When the panel which prepared the projection as domain regulation means, such as the 1st example, was driven, degradation of display quality was seen [near a gate bus line and the data bus line]. The very small domain field which is not desirable occurred near the bus line, and, as for this, saying for turbulence and a speed of response to fall [the orientation of liquid crystal] with the generating understood. Generating of such turbulence reduces a viewing-angle property and a color property further. Such a problem is solved in the 27th example explained below.

[0142] Drawing 114 is drawing showing the example of the pattern which repeats the projection of the straight line shown in the 1st example. This projection pattern was repeated in the pitch predetermined in the projection of fixed height with fixed width of face. therefore, the drawing 114 -- the width of face l and Gap m of a projection -- respectively fixed value l1 m1 it is . In addition, although an example which is different by the projection formed in one substrate about the width of face of a projection and the projection formed in the substrate of another side is shown, about the projection formed for every substrate, width of face l is fixed. Moreover, it was fixed also about height [of a projection] h.

[0143] Drawing 115 is drawing showing the wavelength dispersion property of the optical anisotropy of the used liquid crystal. Short wavelength is known by that retardation deltan becomes large like illustration. Therefore, retardation deltan becomes large in the order of a blue (B) pixel, a green (G) pixel, and a red (R) pixel, and a difference arises in retardation deltan while passing a liquid crystal layer by the color. The thing small as much as possible of this difference is desirable.

[0144] Drawing 116 is drawing showing the projection pattern of the 27th example of this invention. the 27th example -- blue (B) pixel 13B -- green -- by each pixel of (G) pixel 13G and (Red R) pixel 13R, although the width of face l of a projection is the same, the gap m of a projection is made into a different value. concrete -- m -- Bpixel13B -- m1 G pixel 13G -- m2 Rpixel13R -- m3 carrying out -- **** -- m1 >m2 >m3 it is .

[0145] The effect of the electric field vector which a liquid crystal molecule receives becomes strong, and can control the problem of the electric field vector accompanying a drive, so that the gap m of a projection is small.

Drawing 117 is drawing showing the result of having changed the gap of the projection by the relation between applied voltage and permeability, and having measured it, and since a numerical aperture will increase so much if Gap m becomes large, permeability's improves. Since the wavelength dispersion property of the optical anisotropy of liquid crystal is as in drawing 115, by changing the gap m of a projection for every color pixel, as shown in drawing 116, it can make small the difference of retardation deltan while passing a liquid crystal layer by the color, and can improve a color property.
[0146] Drawing 118 is drawing showing the projection pattern of the 28th example of this invention. the 28th example -- blue (B) pixel 13B -- green -- by each pixel of (G) pixel 13G and (Red R) pixel 13R, although the gap m of a projection is the same, width of face l of a projection is made into a different value. Effectiveness is the same as the 27th example. Drawing 119 is drawing showing the projection pattern of the 29th example of this invention. In the 29th example, it sets in each pixel, and is the value m1 small in the field near the gate bus line of a top and the bottom about the gap m of a projection. It carries out and is the big value m2 in a central field. It is carrying out. [near /, such as a gate bus line and a data bus line, / the bus line], by the electric field vector accompanying a drive, the domain which falls on the condition that a liquid crystal molecule does not fit a display may occur, and this was reducing display quality. Effect of the electric field vector which narrows the gap of a projection in the field near a gate bus line in the 29th example, and a gate bus line generates is made hard to be influenced. Generating of the domain which is not desirable is controlled by this, and display quality improves. In addition, since the part numerical aperture will fall and it will become dark if the gap of a projection is narrowed, the larger one of the gap of the projection from the point of a numerical aperture is good. By making it a projection pattern like the 29th example, the effect of the electric field vector which makes decline in a numerical aperture the minimum and a gate bus line generates can be reduced.
[0147] Drawing 120 is drawing showing the pixel structure at the time of actually realizing the projection pattern of the 29th example of drawing 119. Drawing 121 is drawing showing the projection train of the 30th example of this invention. Like illustration, the height of a projection is gradually changed in the 30th example. Drawing 124 is drawing showing change of the permeability of the black condition as opposed to [in drawing 125] the height of a projection for change of the permeability of confession voice [as opposed to the height of a projection for change of applied voltage when change of applied voltage when drawing 122 changes the height of a projection, and the relation of permeability changes the height of a projection in drawing 123, and the relation of a contrast ratio]. It is the result of 7.5 micrometers, 15 micrometers, and cel thickness setting to about 3.5 micrometers the width of face and the gap of a resist in which these drawings form a projection, respectively, setting the height of a resist to 1.537 micrometers, 1.600 micrometers, 2.3099 micrometers, and 2.4486 micrometers, and measuring permeability and a contrast ratio with an experimental device.
[0148] If a resist becomes high, according to it, confession voice (at time of 5V impression) permeability will also increase from this result. Since this has the large projection which bears the auxiliary role for making liquid crystal incline, it is considered to be for a liquid crystal molecule to fall more certainly. The more the height of a projection also increases the permeability (leakage light) in a black condition (at the time of no electrical-potential-difference impressing), the more it increases. This is not so desirable in order to act in the direction on which black level is dropped. Therefore, since contrast (white brightness / black brightness) falls so that a projection becomes high, a protection-from-light ingredient is used as an ingredient of a projection, and, as for the height of a projection, it is desirable not to make it not much high.
[0149] make it any -- since the orientation condition of liquid crystal is changeable by changing the height of a projection, a better display is attained by changing the height of a projection for every color pixel, adjusting a color property or setting up the height of a suitable projection according to distance with a bus line. For example, in R pixels, the height of a projection is made high, the height of a projection is made small in order (G pixels and B pixels), or into 1 pixel, near the bus line, it is high in the height of a projection and the height of a projection is made low in the center section.
[0150] In addition, even if it increased the height of a projection to the same height as cel thickness, it checked once that a screen display was possible satisfactory. therefore, the height of a projection is shown in (1) of drawing 126 -- as -- cel thickness -- the same -- or as shown in (2) of drawing 126, a projection can be prepared in the location where two substrates counter, and the role of a panel spacer can be made a projection by making it the sum of those height become the same as cel thickness.
[0151] Drawing 127 is drawing showing the projection pattern of the 31st example. Here, as shown in (1) of drawing 127, a side face specifies the inclination of the side face of a projection on the square theta with a

substrate (electrode) to make. Suppose that this include angle is called a taper angle. In the 31st example, the taper angle theta of projection 20 presupposes that some values can be taken as shown in (2) of drawing 127. Generally, the orientation condition that liquid crystal falls becomes good, so that the taper angle theta is large. Therefore, since the orientation condition of liquid crystal is changeable by changing the taper angle theta, a better display is attained by changing the taper angle theta for every color pixel, adjusting a color property or setting up the suitable taper angle theta according to distance with a bus line. For example, in R pixels, it is large in the taper angle theta, and the taper angle theta is made small in order (G pixels and B pixels), or near the bus line, it is large in the taper angle theta in 1 pixel, and the taper angle theta is made small in the center section.

[0152] since the orientation restraining force of a projection changes by changing the gap of a projection, width of face, height, a taper angle, etc. as explained above -- every color pixel -- or these conditions are changed within 1 pixel, it distinguishs between the orientation restraining force of a projection partially, and it becomes possible to bring the viewing-angle property and speed of response of liquid crystal close to an ideal condition. As shown in drawing 115, the retardation of liquid crystal is dependent on wavelength. Then, while raising the brightness of a white display paying attention to this property, the example of the liquid crystal panel which realized the speed of response high about all color pixels is explained.

[0153] First, the wavelength dependency of VA method is explained briefly. Drawing 128 is drawing showing change by electrical-potential-difference impression of the twist angle of a liquid crystal layer at the time of giving a twist angle by the liquid crystal display panel of a perpendicular orientation (VA) method using the liquid crystal (n mold liquid crystal) which has a negative dielectric anisotropy. At the time of no electrical-potential-difference impressing, on one substrate front face, orientation is carried out in the direction of 90 degrees, and orientation is carried out in the direction of 0 times, and it is twisting 90 degrees in the substrate front face of another side. Although only the liquid crystal molecule near the substrate front face will twist along with the achoring energy on the front face of a substrate if an electrical potential difference is impressed in this condition, in the other layer, the twist hardly occurs. Therefore, it does not become rotatory-polarization (TN) mode substantially, but becomes birefringence mode. Drawing 129 is drawing showing change of the relative luminance (permeability) to change of retardation deltand in TN mode and birefringence mode. Like illustration, birefringence mode shows a steeper permeability property to deltand of liquid crystal compared with TN mode. As mentioned above, in the perpendicular orientation liquid crystal using n mold liquid crystal, a polarizing plate is used as a cross Nicol's prism, and it is considering as the white display at the time of a black display and electrical-potential-difference impression at the time of no electrical-potential-difference impressing.

[0154] Drawing 130 is drawing showing change of the permeability to change of deltand in each wavelength (R:670nm, G:550nm, B:450nm). If permeability sets the thickness of a liquid crystal layer as the greatest deltand from this drawing to deltand from which the brightness in a white display serves as max, i.e., the wavelength of 550nm, since the permeability to 450nm will become low too much, the thickness of a liquid crystal layer was set up thinness from the thickness which can be found from brightness max, and coloring in a white display has been pressed down. Therefore, the brightness in a white display is dark compared with TN mode, and in order to obtain white brightness equivalent to the liquid crystal display panel in TN mode, it is necessary to make back light brightness bright. However, for making back light brightness bright, it is necessary to enlarge power consumption of lighting, and the applicability of a panel will be limited. since [moreover,] the permeability to 450nm becomes low too much compared with TN mode when thickness of a liquid crystal layer is thickened by white brightness serious consideration -- a white display -- setting -- a panel -- **** stripes with yellow -- it might be unacquainted and there was a problem.

[0155] on the other hand, in order to extend the visual field range, adding a phase contrast film was performed, but when the thickness of a liquid crystal layer became thick, color change of the direction of a polar angle (right and left) became large, and even when the retardation value of a phase contrast film was the same, there was a problem that the color difference became larger. So, in the 32nd example, the thickness of the liquid crystal layer of each color pixel is set up according to an individual so that permeability may serve as max at the time of driver voltage impression. A difference arises in a speed of response, and when action indication is performed, it becomes impossible however, to display a color tone correctly, if the thickness of a liquid crystal layer differs. So, in setting the thickness of a liquid crystal layer as a different value for every color pixel, the means which makes the speed of response of liquid crystal homogeneity is needed.

[0156] Drawing 131 is drawing showing change of the liquid crystal speed of response to the gap of the projection or slit at the time of setting up deltand of a liquid crystal layer so that the permeability greatest on three sorts of above-mentioned wavelength may be obtained in a liquid crystal layer. A liquid crystal speed of response falls as the thickness of a liquid crystal layer becomes thick. In the LCD panel of VA method which controls orientation using a projection, although a liquid crystal speed of response changes with the dielectric constant of a projection, a projection configuration, the gaps of a projection, etc., if a dielectric constant, the configuration of a projection, and height are fixed, a speed of response will become quick, so that the gap of a projection becomes narrow. It is drawing 131, for example, in order to set the speed of response of liquid crystal to 25ms, the gap of a projection or a slit is known by that it is necessary to set it as 25 micrometers in G pixels, and to set it as 20 micrometers by B pixels at 30 micrometers by R pixels.
[0157] Moreover, drawing 132 is drawing showing a projection or change of the numerical aperture to the gap of a slit. In R pixels, in 20 micrometers, when it is set as 25 micrometers in G pixels and set as 30 micrometers in B pixels, a numerical aperture becomes 80%, 83.3%, and 85.7%, and a difference produces the gap of a projection or a slit from drawing 131 at a numerical aperture, respectively. While setting up according to the individual so that permeability might serve as max in the thickness of the liquid crystal layer of each color pixel in the 32nd example in consideration of the above point at the time of driver voltage impression, the area of each color pixel was changed so that the gap of a projection might be adjusted, the speed of response in each color pixel might be made in agreement and a numerical aperture might be further in agreement.
[0158] Drawing 133 is drawing showing the panel structure of the 32nd example. Like illustration, there was no R pixel part in both substrates 16 and 17, and a G pixel part is 0.55 micrometers in thickness, and formed the structure 71 whose thickness of a B pixel part is 1.05 micrometers. This thickness computed optimum conditions by the simulation about the birefringence mode of VA method in which n mold liquid crystal was used. furthermore, the height of projection 20A -- by R pixels, it was made 1.9 micrometers by G pixels, and was made 2.45 micrometers by B pixels at 1.4 micrometers. furthermore, the gap of a projection -- by R pixels, it was made 25 micrometers by G pixels, and was made 20 micrometers by B pixels at 30 micrometers. Furthermore, B pixels : G pixels : R pixels surface ratio was set to 1:1.03:1.07. That is, pixel area was made into R pixels > G pixels > B pixels order.
[0159] Acrylic resin was used for the structure 71, and after applying the resist so that it might become the thickness of 1.4micro by B pixels, it considered it as the projection with a width of face of 5 micrometers by the photolithography. Moreover the perpendicular orientation film was applied, the 3.6-micrometer spacer was sprinkled, the seal was formed, and liquid crystal after hardening was poured in for lamination and a seal. thus, the thickness of a liquid crystal layer -- by R drawing, it is set to 4.6 micrometers in G pixels, and is set 3.6 micrometers to 5.7 micrometers by B drawing.
[0160] Drawing 134 is drawing showing the panel structure of the modification of the 32nd example which formed the projection in the CF substrate 16 and formed the slit 21 in the pixel electrode 13 of the TFT substrate 17. In this modification, there was no R pixel part in the CF substrate 16, and a G pixel part is 1.1 micrometers in thickness, and formed the structure 71 of the acrylic resin whose thickness of a B pixel part is 2.1 micrometers. After applying so that it might become the thickness of 1.4micro by B pixels about a resist on it, it considered as the projection with a width of face of 5 micrometers by the photolithography. thereby -- the height of a projection -- by R pixels, it is set to 2.5 micrometers by G pixels, and is set to 1.4 micrometers to 3.5 micrometers by B pixels. the gap of projection 20A and a slit -- by R pixels, it was made 25 micrometers by G pixels, and was made 20 micrometers by B pixels at 30 micrometers. B pixels : G pixels : R pixels surface ratio was set to 1:1.03:1.07.
[0161] The biaxial phase contrast film (retardation value of 320nm of the thickness direction) which set the panel of the 32nd example manufactured as mentioned above and its modification by deltand of a G-pixel liquid crystal layer was added, and the color difference in panel permeability, an angle of visibility, and the direction of a polar angle (0 times [-80]) was measured. The result is shown in drawing 252. In addition, Example A shows the 32nd example, Example B shows a modification, and drawing 252 shows the measurement result in the conventional example which changed the thickness of a liquid crystal layer as a reference value.
[0162] In order to gather permeability as shown in drawing 252, and the conventional example 1 shows, if thickness of a liquid crystal layer is thickened, the permeability (brightness) in a transverse plane will be made highly, but since the optical path length becomes long in the direction of a polar angle, the permeability of each wavelength is changed sharply and the color difference becomes large. On the other hand, by the panel of the

32nd example and its modification, in order to equalize the speed of response of liquid crystal, projection or gap width of face of a slit is narrowed by G pixels with R pixels, and the part permeability with a low numerical aperture is falling from the conventional example 2. However, since the thickness of each liquid crystal layer is set up so that it may become permeability max at the time of driver voltage impression (white display), the color difference in the direction of a polar angle is small.

[0163] White brightness can be made bright just like TN mode, without coloring a panel in the large angle-of-visibility range, if it is the panel of the 32nd example and its modification. Moreover, since the liquid crystal speed of response is equalized according to the thickness of a liquid crystal layer, even when a movie display is performed, the good display of color reproduction nature is obtained. Next, the structure form of a projection is explained.

[0164] When forming a projection on the electrode 12 of the CF substrate 16 and the TFT substrate 17, and 13, after forming an electrode by the ITO film, it is possible to apply a resist and to carry out pattern NINGU by the photolithography. If it is this approach, since it can make with a well-known technique, explanation is omitted here. When making a projection by the above approaches, it will be necessary to establish the process for forming a projection pattern independently. If a projection can be formed in a TFT substrate, using the conventional process as it is, the increment in a process can be prevented. When it is possible to carry out patterning of the insulating layer used at the conventional process further, and to leave a projection pattern, in forming an insulating projection and forms a conductive projection, it is possible to carry out patterning of the conductive layer used at the conventional process further, and to leave a projection pattern.

[0165] Drawing 135 is drawing showing the structure of the TFT substrate of the 33rd example. It is the structure for forming an insulating projection in the 33rd example using the insulating layer used at the conventional process. With this structure, the ITO electrode 13 is formed first, an insulating layer is formed on it, and the part of the ITO electrode 13 is removed. At this time, it leaves the part of projection 68. Furthermore, although the gate electrode 31 is formed, and an insulating layer is formed further and removed except a required part, if the thickness of a projection is required at this time, it will leave the part of projection 68. The rest forms a data bus line and TFT as usual. A reference number 41 is a drain electrode (data bus line), 65 is a channel protective coat by a diagram, it is a wiring layer for 66 to separate a component, and 67 is the layer of a transistor of operation. The ITO electrode 13 and a source electrode are connected by the hole.

[0166] Drawing 136 is the example of the projection pattern manufactured in the 33rd example, is the parallel projection of the shape of a straight line for (1) to form two orientation division fields, and is a zigzag projection for (2) to form four orientation division fields. In drawing, the part shown with a reference number 68 is equivalent to a projection, and 69 is equivalent to a part for a picture element part. Drawing 137 is drawing showing the panel structure of the 34th example. It is the structure for forming a conductive projection in the 34th example using the conductive layer used at the conventional process. With this structure, the TFT protection-from-light metal layer 70 for shading TFT first is formed, an insulating layer is formed on it, and the ITO electrode 13 is formed further. Furthermore, an insulating layer is formed, a data bus line and the source 41 of TFT, and a drain 42 are formed, and an insulating layer 72 is formed on it. And although the layer of the gate electrode 31 is formed and this layer is removed except for the part of a gate electrode, it leaves partial 20B of a projection then.

[0167] Drawing 138 is the example of the projection pattern manufactured in the 34th example, is the parallel projection of the shape of a straight line for (1) to form two orientation division fields, and is a zigzag projection for (2) to form four orientation division fields. In drawing, the part shown by reference number 20B is equivalent to a projection. A reference number 35 is CS electrode. Although the CS electrode 35 is prolonged along with the edge of a pixel electrode so that it may act as a black matrix, it is separated with projection 20B. Although the CS electrode 35 becomes a certain electrical potential difference to the pixel electrode (ITO electrode) 13, this is because there is a possibility of having a bad influence on the orientation of liquid crystal, when this electrical potential difference is impressed to projection 20B.

[0168] Drawing 139 is drawing showing the process which manufactures the TFT substrate of the panel of the 35th example. As shown in (1), pattern NINGU of the gate electrode 31 is carried out on a glass substrate 17. Next, the SiNx layer 40, the amorphous silicon (alpha-Si) layer 72, and the SiNx layer 65 are formed in order. Furthermore, as shown in (2), it leaves only the part of a channel protective coat and the SiNx layer 65 is etched to the alpha-Si layer 72. Furthermore, n+ An alpha-Si layer and the Ti/aluminum/Ti layer equivalent to a data bus line, the source 41, and a drain 42 are formed, and it etches so that it may leave only the part which is

equivalent to a data bus line, the source 41, and a drain 42 in pattern NINGU. As shown in (4), after forming the SiNx layer equivalent to the last protective coat 43, it leaves the parts 43B and 40B equivalent to a part and a projection required for an insulation, and etches to the front face of a glass substrate 17. At this time, the contact hole of the source electrode 41 and a pixel electrode is also formed in coincidence. Under the present circumstances, the source electrode 41 becomes an etching stopper. Furthermore, pattern NINGU of the ITO electrode layer is formed and carried out, and the pixel electrode 13 is formed. Therefore, the height of a projection serves as the SiNx layer 40 and the sum of the last protective coat 43.

[0169] Drawing 140 is drawing showing the structure of the modification of the panel of the 35th example, and when etching the SiNx layer equivalent to the last protective coat 43, it is etched to the top face of the SiNx layer 40. Therefore, the height of a projection is the thickness of the last protective coat 43. Drawing 141 is drawing showing the process which manufactures the TFT substrate of the panel of the 36th example. As shown in (1), pattern NINGU of the gate electrode 31 is carried out on a glass substrate 17. Next, pattern NINGU of the ITO electrode layer is formed and carried out, and the pixel electrode 13 is formed. As shown in (2), the SiNx layer 40, the amorphous silicon (alpha-Si) layer 72, and the SiNx layer 65 are formed in order. Furthermore, it leaves only the part of a channel protective coat and the SiNx layer 65 is etched to the alpha-Si layer 72. Furthermore, n+ The alpha-Si layer 73 is formed. As shown in (3), it leaves partial 40B equivalent to a required part and a required projection, and etches to the front face of the pixel electrode 13. As shown in (4), the Ti/aluminum/Ti layer equivalent to a data bus line, the source 41, and a drain 42 is formed, and pattern NINGU is carried out so that it may leave only the part equivalent to a data bus line, the source 41, and a drain 42. And it is n+, using a data bus line, the source 41, and a drain 42 as a mask. The alpha-Si layer 73 and the alpha-Si layer 72 are etched. As shown in (5), after forming the SiNx layer equivalent to the last protective coat 43, it leaves the parts 43B and 40B equivalent to a part and a projection required for an insulation, and etches to the front face of the pixel electrode 13.

[0170] As mentioned above, although the example about manufacture of projection 20B by the side of the TFT substrate 17 was explained, there are various kinds of modifications according to the structure of the TFT substrate 17 etc. make it any -- a manufacturing cost can be reduced by using with the process of other parts of the TFT substrate 17 in common, and manufacturing a projection. As already explained, since the direction of the orientation regulation by the slant face and the direction of the projection of the dielectric prepared on the electrode of the orientation regulation by the electric field in a projection part correspond, it has the advantage that the stable orientation is obtained. However, a projection is the dielectric prepared on the electrode, since the orientation film is formed on it, in inter-electrode [of a pair], the inside of a liquid crystal cell serves as unsymmetrical structure, and a charge tends to collect with impression of an electrical potential difference. Therefore, the residual DC electrical potential difference became high, and there was a problem that the phenomenon called the so-called "printing" occurred.

[0171] Drawing 142 is drawing showing the relation between the thickness of the dielectric on an electrode, and the magnitude of a residual DC electrical potential difference, and (1) is the graph which shows the relation and it shows the part in which (2) is equivalent to thickness d of a dielectric, and the location where "printing" occurs. As the perpendicular orientation film 22 is also a dielectric and is shown in (2) of drawing 142, the height of a projection and the sum of the perpendicular orientation film 22 are equivalent to thickness d of a dielectric. As shown in (1) of drawing 142, a residual DC electrical potential difference increases with the increment in d. Therefore, it is easy to generate printing in the part of projection 20 shown in (2) of drawing 142. This is also the same as when forming a hollow with a dielectric on an electrode like the 18th example of drawing 95. It is made for such a problem not to occur in the 37th example explained below.

[0172] Drawing 143 is drawing showing the projection structure of the 37th example, (1) is the perspective view of projection 20 and (2) is a sectional view. Like illustration, projection 20 has width of face of 7 micrometers, and width of face on top is [height] about 1-1.5 micrometers in about 5 micrometers. Besides, many detailed holes are established in the field. The diameter of this detailed hole is 2 micrometers or less. Drawing 144 is drawing showing the structure form of the projection (CF substrate side) which has the above-mentioned detailed hole. As shown in (1), the glass substrate with which the counterelectrode 12 of the ITO film was formed is washed. As shown in (2), on it, sensitization resin (resist) and the resist layer 351 is formed. [apply and] As shown in (3), the mask pattern 352 which penetrates parts other than a projection and the part of a hole is stuck, and it exposes. The projection 20 as developed this and shown in (4) was obtained. Furthermore, if BEKU, projection 20 will contract, and as shown in (5), a side face will turn into a slant face.

[0173] When what formed the detailed hole in the projection as mentioned above, and the substrate which is not formed were assembled and the residual DC electrical potential difference was measured by flicker method of elimination (DC:3V and AC:2.5 V and the temperature C of 50 degrees, DC impression time amount 10 minutes), when a detailed hole was formed, it was 0.09V, and it was 0.25V when the detailed hole was not formed. Thus, since a residual DC electrical potential difference is reduced, printing stops being able to occur easily.
[0174] Orientation of the liquid crystal molecule is carried out at right angles to slant faces, such as a projection, and it carries out orientation at right angles to electric field. However, when spacing of a projection became small to extent of the above-mentioned detailed hole, it turned out that orientation will not be carried out to the slant face of a detailed part. Therefore, in the part of the top face of a projection, orientation is carried out according to it in response to the effect of the orientation by the slant face of both sides. Drawing 145 is drawing showing the projection structure of the 38th example. In the 38th example, the slot where thickness with a width of face of 3 micrometers is thin was established in the bottom of projection 20B of 7.5-micrometer width of face by the side of a TFT substrate. Furthermore, the protection-from-light layer 34 of chromium nature is formed in the bottom of projection 20B. Such projection 20B can be manufactured by the same approach as the 37th example. It is 0.10V and the result comparable as the 37th example was obtained by the result of having measured the residual DC electrical potential difference with the projection structure of the 38th example.
[0175] Although a liquid crystal molecule may not carry out orientation in the direction perpendicular to a substrate in the part of a slot at the time of no electrical-potential-difference impressing but a perpendicular stacking tendency may deteriorate like illustration with the projection structure of the 38th example, since the light-shielding film 34 is formed and the leakage light by the abnormalities in orientation of this part is shaded, contrast does not fall. Next, it investigated about the cross-section configuration of the projection made from the resist. Usually, the resist is carrying out the cross-section configuration as shown in (1) of drawing 146 immediately after patterning. However, in the case of the method of this invention, the orientation by which the cross section of the boiled-fish-paste (cylinder) form which had a gently-sloping inclination somewhat as a cross-section configuration was stabilized more is obtained. The substrate immediately after patterning was calcinated by 200-degreeC, and it was made to change to a configuration as shows the cross-section configuration of a resist to (2) of drawing 146 here. Drawing 147 is drawing showing change of the cross-section configuration of the resist when changing the temperature which calcinates the resist which carried out patterning. Even if it raised burning temperature more than 150-degreeC, the change beyond it of a cross-section configuration was small.
[0176] It is [besides changing the cross-section configuration of a resist / another / important] reasonable to have calcinated the resist by 200-degreeC. The resist used for the prototype will react with the solvent of the orientation film only by performing the usual baking processing (135-degree-C 40 minutes), and the reason will melt. In this example, the resist is calcinated at temperature high beforehand enough before orientation film formation, and it prevented reacting with the orientation film.
[0177] In addition, in examples which create the projection explained until now, such as the 1st example, a resist is calcinated by 200-degreeC, the cross-section configuration of a resist is made into the shape of boiled fish paste, and the data explained until now are also twisted to the projection pattern of a boiled-fish-paste-like cross-section configuration. In the above-mentioned example, although the cross-section configuration of a resist was made into the boiled-fish-paste (cylinder) form with burning temperature, depending on the line breadth of a resist, it becomes nature and a boiled-fish-paste form. Drawing 148 is drawing showing the line breadth of a resist, and the relation of a cross-section configuration. Line breadth has nature and a desirable boiled-fish-paste form in about 5 micrometers. From now on, if it is about 7 micrometers or less in line breadth, it will be thought that the resist of the cross-section configuration of a natural boiled-fish-paste form is obtained. With the present equipment, although the line breadth of 5 micrometers is realistic, it is thought that the same orientation is theoretically obtained with the engine performance of an aligner even if it is submicron line breadth.
[0178] a projection -- the TFT flattening agent made from JSR -- when generated using positive type photoresists, such as HRC-135, the front face had inadequate wettability with the ingredient of the perpendicular orientation film, the ingredient of the applied perpendicular orientation film was crawled, and the problem that the perpendicular orientation film was not formed on the surface of a projection occurred. Drawing

149 is a sectional view of the panel at the time of using a projection as a domain regulation means, and is drawing showing the situation of a height. As shown in (1) of drawing 149, a color filter, a bus line, etc. are formed on substrates 16 and 17, and the ITO electrodes 12 and 13 are formed further. Projections 20A and 20B are formed on it, and the ingredient of the perpendicular orientation film 22 is applied on the ITO electrode 12 including Projections 20A and 20B, and 13. However, the front face of the photoresist of Projections 20A and 20B had inadequate wettability with the ingredient of the perpendicular orientation film, as shown in (2) of drawing 8, it crawled the ingredient of the applied perpendicular orientation film, and the problem that the perpendicular orientation film 22 was not formed in the front face of Projections 20A and 20B had generated it. Such a problem is solved in the 39th example.
[0179] In the 39th example, the front face of a projection is processed so that the ingredient of the perpendicular orientation film may make it easy to be attached to the front face of a projection. It is possible to form detailed irregularity on the surface of a projection as processing the ingredient of the perpendicular orientation film makes it easy to be attached to the front face of a projection, and to raise the spreading nature of the ingredient of the orientation film, or to raise wettability with the ingredient of the perpendicular orientation film of the front face of a projection. If detailed irregularity is formed on the surface of a projection, when the ingredient liquid of the orientation film collects especially on the part of concave, crawling of the ingredient of the orientation film on the front face of a projection will be reduced. as the concavo-convex formation approach -- chemical preparation and physical processing -- it is -- as chemical preparation -- ashing -- processing is effective.
[0180] drawing explaining an example of the manufacture approach of a projection [in / in drawing 150 / the 39th example] -- it is -- ashing -- it is the example which uses processing. As shown in (1) of drawing 150, projection 20 is formed using the above-mentioned photoresist on an electrode (in this case, a counterelectrode 12 is sufficient although it is the pixel electrode 13.) 13. For example, projection 20 has the shape of a stripe with a width of face [of 10 micrometers], and a height of 1.5 micrometers. Annealing treatment of this is carried out and a cross section is made into the shape of boiled fish paste. this substrate -- a well-known plasma asher -- a projection front face -- ashing -- it processes. Of such plasma ashing processing, a detailed hollow as shown in (2) of drawing 150 is formed in a projection front face. In this way, the obtained substrate is washed and dried and perpendicular orientation material is applied using a printing machine. At this time, of the effectiveness of the irregularity formed on the projection, crawling of orientation material does not happen, but as shown in (3) of drawing 150, the perpendicular orientation film is formed all over a projection. Then, a process is advanced in the same process as the usual multi-domain VA method. In this way, the obtained liquid crystal display has a good display property without the poor display by crawling of the orientation film.
[0181] ashing -- as processing, there is other ozone ashing processing and the effectiveness as plasma ashing processing that this was also the same was acquired. Brush washing of the substrate is carried out after the annealing treatment of a projection, using substrate ******** as an approach of forming irregularity physically. Thereby, stripe-like irregularity is formed on a projection. Rubbing is carried out with the rubbing roller 210 which has fiber 211 on a front face, or as an approach of forming irregularity physically, otherwise, as shown in (1) of drawing 151, as shown in (2), the irregular roller 213 is pushed against the substrate with which the projection 20 was formed, and there is the approach of imprinting the irregularity of a roller 213.
[0182] Drawing 152 is drawing explaining the processing which irradiates ultraviolet rays as processing which raises wettability with the ingredient of the perpendicular orientation film on the front face of a projection. As explained until now, the same projection 20 as drawing 150 is formed by the photoresist on a substrate. Excimer UV irradiation equipment is used for this substrate, and they are 1000 mJ/cm2 in the environment of 20% or more of oxygen densities. With an exposure, ultraviolet rays with a dominant wavelength of 172nm are irradiated. Thereby, the wettability to the ingredient of a substrate and the perpendicular orientation film on a projection improves. In this way, the obtained substrate is washed and dried and perpendicular orientation material is applied using a printing machine. At this time, of the wettability improvement effect by ultraviolet rays, crawling of orientation material does not happen but the perpendicular orientation film is formed all over a projection. Then, a process is advanced in the same process as the usual multi-domain VA method. In this way, the obtained liquid crystal display has a good display property without the poor display by crawling of the orientation film. Drawing 153 is a graph which shows change of the rate of crawling of the ingredient of the perpendicular orientation film when changing the conditions of the ultraviolet rays which irradiate the projection formed by the photoresist. (1) of drawing 153 is a graph with which wavelength and an exposure

show relation with a rate soon. Its time of 200nm or less is effective, and the wavelength of ultraviolet rays has a very small improvement effect, when it is the wavelength beyond it. Moreover, it is 1000 mJ/cm<SUP>2 when the wavelength of ultraviolet rays is 200nm or less. It stopped generating crawling in an exposure. (2) of drawing 153 -- wavelength -- ultraviolet rays 200nm or less -- 1000 mJ/cm2 The oxygen density when irradiating is a graph which shows relation with a rate soon. In the environment where an oxygen density is low, since sufficient quantity of ozone does not occur, it is thought that an improvement effect is small. Therefore, wavelength is ultraviolet rays 200nm or less in the environment of 20% or more of oxygen densities 1000 mJ/cm2 Irradiating above is desirable.
[0183] As equipment which wavelength makes generate ultraviolet rays 200nm or less, there is a low-pressure mercury lamp other than above excimer UV irradiation equipment, and this may be used. Moreover, in the above-mentioned processing, although substrate washing and desiccation were performed after the exposure of ultraviolet rays, it may be made to irradiate ultraviolet rays after substrate washing and desiccation. In this case, since the exposure of ultraviolet rays is performed just before orientation film printing, reduction of the wettability improvement effect by the neglect and washing after an exposure can be prevented.
[0184] Moreover, if the orientation film is formed after applying a silane coupling agent, an orientation film solvent, etc. before spreading of the orientation film, crawling on a projection will be improved sharply. BEKU (annealing) processing of the substrate is carried out, and, specifically, the configuration of a projection is used as a boiled-fish-paste mold as shown in drawing 146. A hexa methyl disilane (HMDS) is applied after washing this substrate using a spinner. Perpendicular orientation material is applied to this using a printing machine. Thereby, the perpendicular orientation film was formed good on the surface of the projection. In addition, you may make it apply N-methyl pyrrolidone (NMP) instead of HMDS. Furthermore, even if it is made to carry out within the NMP ambient atmosphere which had printing of the perpendicular orientation film sealed, the perpendicular orientation film can be formed good on the surface of a projection. In addition, if it considers as the solvent applied before formation of the perpendicular orientation film, various ****s, for example, the gamma-butyrolactone which is the solvent of the perpendicular orientation film, butyl cellosolve, etc. can be used.
[0185] Drawing 154 is drawing explaining an example of the manufacture approach of the projection in the 39th example, and is an example (example by the side of CF substrate) which forms a projection with the ingredient which distributed the particle. As shown in (1), particle size applies the positive type photopolymer (resist) 355 in which the particle 357 of an alumina 0.5 micrometers or less was made to mix 5 to 20% on an electrode 12. As shown in (2), negatives are exposed and developed to this using the photo mask 356 which shades a projection part. Furthermore, if BEKU, projection 20A as shown in (3) will be obtained. The particle 357 of an alumina projects in the front face of this projection 20A, or irregularity with the hole detailed on formation now a cage, and a front face where the particle 357 of an alumina was missing is formed in it. Therefore, the wettability when applying the perpendicular orientation film improves.
[0186] When the rate of the particle of an alumina exceeds 20%, the photosensitivity of a resist falls and it stops being able to carry out pattern NINGU by exposure, although it is necessary to make the rate of the particle of the alumina mixed in a resist increase in order to make [many] irregularity of the front face of a projection in the above-mentioned example. Drawing 155 is drawing showing the manufacture approach of the projection in the case of making [many] irregularity of the front face of a projection.
[0187] As shown in (1) of drawing 155, particle size applies the nonphotosensitivity resin which mixed the particle 357 of an alumina 0.5 micrometers or less at a big rate on an electrode 12. Furthermore, as shown in (2), a resist is applied to the front face, and negatives are exposed and developed using the photo mask 358 which shades a projection part. Since a resist remains only in the part corresponding to a photo mask 358 by this, if it etches, nonphotosensitivity resin other than a projection part will be removed. Furthermore, if BEKU, projection 20A as shown in (3) will be obtained. Although irregularity is similarly formed in the front face of this projection 20A, since the rate of the particle 357 of the mixed alumina is large, much irregularity is formed and the wettability in the case of applying the perpendicular orientation film from the example of drawing 154 improves further.
[0188] Drawing 156 is drawing showing the another manufacture approach which forms irregularity in the front face of a projection by the particle. In this example, after applying a resist 360 to the front face of an electrode 12, sprinkle the particle 361 of an alumina and it is made to adhere to the front face of a resist 360, and it prebakes after that. As usual, if pattern NINGU of the projection is carried out, projection 20A as shown in (2)

will be obtained by the back. If this is washed, since the particle 361 of an alumina exists or the hole where the particle 361 of an alumina fell out exists, irregularity will be formed in the front face of projection 20A.
[0189] Drawing 157 is drawing explaining an example of the manufacture approach of the projection in the 39th example, and is an example which a projection ingredient is made to foam and forms irregularity in a front face. The resist which forms projection 20 is applied by a spinner etc., after solvents, such as PGMEA (propylene-glycol-monomethyl-ether acetate), melt. It is prebaked by 60-degreeC on it (PURIKYUA). In this condition, a lot of solvents remain into the resist. It mask-exposes, and negatives are developed and pattern NINGU of this is carried out.
[0190] As a broken line shows in drawing 158, after making it go up to 200-degreeC slowly over 10 minutes within clean oven and holding more than for 75 minutes in the condition conventionally, it had returned to ordinary temperature slowly over 10 minutes. On the other hand, in this example, it lays on the hot plate of 200-degreeC, and heats for 10 minutes. At this time, about 1 minute is taken for the temperature of a substrate to rise to 200-degreeC. Then, it cools radiationally for 10 minutes and returns to ordinary temperature. Thus, if sudden heating is carried out, as shown in (1) of drawing 157, the solvent in a resist will bump, and a bubble 362 will arise inside. In this bubble 362, as shown in (2) of drawing 157, the above is emitted outside from the front face of projection 20. The foaming marks 363 are formed in the front face of a projection at this time, and irregularity is produced.
[0191] In addition, if it stirs before applying the resist melted to the solvent, and air bubbles are introduced into a resist, it will become easy to foam by the time of carrying out sudden heating of the resist. Moreover, you may stir, introducing nitrogen gas, carbon dioxide gas, etc. While the air bubbles of gas are introduced into a resist by this, since it dissolves into a solvent, the fizz of gas [a part of] at the time of heating increases. Moreover, the clathrate compound which emits the water of crystallization which dehydrates about [120-200 degrees] by C, and a guest solvent to a resist may be mixed. Since water is emitted from water of crystallization, it becomes a steam or a guest solvent is emitted by this at the time of heating, it becomes easier to foam. Moreover, the silica gel which adsorbed a solvent or gas may be mixed into a resist. Since the solvent or gas to which it is sticking from silica gel is emitted by this at the time of heating, it becomes easier to foam. In addition, the solid ingredient to mix needs to be the magnitude below the height and width of face of a projection, and it is ground so that it may become such magnitude.
[0192] also making it such structure, although the detailed hole was established in the projection in the 37th example and the slot was established in the projection in the 38th example -- the front face of a projection -- the perpendicular orientation film -- forming -- ** -- it becomes. Drawing 159 is drawing showing the option which makes the projection which has a slot like the 38th example. As shown in (1) of drawing 159, the photoresist used for creation of a micro lens is used, it approaches and projections 365 and 366 are formed. This photoresist can change the configuration in which pattern NINGU was carried out by the exposure reinforcement of light, baking (BEKU) temperature, presentation, etc., a projection collapses and by setting up suitable baking conditions comes to show it to (2). If the perpendicular orientation film 22 is applied to this, since the center section of the projection 20 has become depressed as shown in (3), the perpendicular orientation film 22 will be formed good. After applying the above-mentioned ingredient to the thickness of 1.5 micrometers, pattern NINGU of the projections 365 and 266 was carried out so that it might become width of face of 3 micrometers, and spacing of 1 micrometer of a projection. And BEKU [180 degreeC] from 10 minutes for 30 minutes. Thereby, two projections united and it became as shown in (2) of drawing 159. The desired configuration was acquired by controlling the time amount of BEKU. If the height of a projection is set to 5 micrometers or more, projections 365 and 266 influence cel thickness (thickness of a liquid crystal layer), and although it seems that two projections will unite if 0.5 micrometers to 5 micrometers and width of face is [height] 2 micrometers to 10 micrometers and the range of spacing is 0.5 to 5 micrometers, when pouring in liquid crystal, they will become hindrance. Moreover, if width of face of a projection is set to 2 micrometers or less, the orientation restraining force of a projection will decline. Furthermore, if it is difficult to unite two projections if spacing of a projection is set to 5 micrometers or more and it makes it 0.5 micrometers or less, a hollow will not be made in the center.
[0193] As mentioned above, although the wettability improvement processing to the ingredient of the orientation film of the projection in the 39th example was explained, what kind of pattern is sufficient as a projection, and a cross-section configuration does not need to be a boiled-fish-paste mold, either. Furthermore, the ingredient which forms a projection just also forms a projection not only in a photoresist but in a desired

configuration. However, if it takes into consideration forming irregularity chemically or physically in a next process, the thing in which ashing is possible is [that it is hard to separate softly as the quality of the material] suitable. As an ingredient which suits this condition, resin ingredients, such as a photoresist, black matrix resin, color filter resin, overcoat resin, and polyimide, are suitable. Moreover, with such an organic material, surface reforming (processing) is possible by ashing, UV irradiation, etc.

[0194] As explained above, since the wettability to the ingredient of the orientation film on the front face of a projection is improved, while failure that the orientation film is not formed in a projection front face can be prevented and display quality improves, the yield improves in the 39th example. In order to prevent conventionally the fall of the contrast by the leakage light which passes the part between each pixel, preparing the so-called black matrix in the periphery of each pixel is performed. Drawing 160 is drawing showing the panel structure of the conventional example where the black matrix was established. Like illustration, on the color filter (CF) substrate 16, R (red) filter 39R, G (Green) filter 39G, and B (blue) filter 39B are formed corresponding to a RGB pixel, and the ITO electrode 12 is formed on it. Furthermore, the black matrix 34 is formed in the boundary part of each RGB pixel. A data bus line, a gate bus line, or the TFT component 33 is formed in the TFT substrate 17 with the ITO electrode 13. The liquid crystal layer 3 is formed between two substrates 16 and 17.

[0195] Drawing 161 is drawing showing the panel structure of the 40th example of this invention, and drawing 162 is drawing showing the projection pattern in the pixel of the 40th example. Like illustration, R filter 39R, G filter 39G, and B filter 39B are formed on the CF substrate 16. Although not illustrated in drawing 161, as shown in drawing 162, projection 20A for orientation control prepared with the liquid crystal panel of the 1st example is formed in the CF substrate 16. This projection 20A is made from the ingredient of protection-from-light nature. The projection 77 is formed in the periphery of each pixel, this projection 77 is also made from the protection-from-light nature ingredient, and it functions as a black matrix. Therefore, it is not necessary to form the black matrix 34 like the conventional example. The projection 77 which functions as this black matrix can be formed in projection 20A and coincidence, and if such a manufacture approach is used, it can skip the black matrix creation process of the creation time of the CF substrate 16. In addition, a reference number 78 is the part of TFT of each pixel, and projection 77 is formed so that this part may also shade.

[0196] In addition, in drawing 161, although projections 20A and 77 are formed in CF substrate side 16, both projection 77 or the projections 20A and 77 may be formed in the TFT substrate 17 side. Thereby, it becomes unnecessary to take into consideration gap of the lamination of CF substrate side 16 and the TFT substrate 17, and the numerical aperture of a panel and the yield of a lamination process can be raised by leaps and bounds. the part which shifted when a black matrix was prepared in the CF substrate 16 side, the ITO electrode 13 of the TFT substrate 17 and opening (part without a black matrix) of the CF substrate 16 were similarly completely designed and lamination gap occurred in a panel production process -- optical leakage -- a lifting -- a normal display is not obtained. Usually, no matter highly precise equipment [what / lamination] it may use, about **5 micrometers of doubling errors exist. Therefore, in consideration of the margin of the part, he designs opening of a black matrix more smallish, and is trying for such a problem not to arise. That is, he is trying for a black matrix to cover about 5-10 micrometers to the inside from the ITO electrode 13 by the side of the TFT substrate 17. If projection 77 is formed in the TFT substrate 17 side, since it is not influenced by lamination gap, a numerical aperture can be made high to the maximum extent. This effectiveness becomes larger as the pixel of a panel becomes small (i.e., so that resolution goes up). For example, in order to take an every 5 micrometers margin if it is the conventional method although the substrate whose dimensions of the ITO electrode of a pixel are 80 micrometers wide and 240 micrometers long was used in this example, it becomes 70 micrometers wide and 230 micrometers long opening, and the opening area of a pixel is 2 16100 micrometers. It becomes. on the other hand -- this example -- the opening area of a pixel -- 19200micrometer2 it is -- a numerical aperture is improved about 1.2 times of the conventional method. If a display twice the resolution of this panel, then the dimension of an electrode are 40 micrometers wide and 120 micrometers long and it is the conventional method, the opening area of a pixel is 2 3300 micrometers. If it becomes and is this example, the opening area of a pixel is 2 4800 micrometers. It becomes and will be improved about 1.5 times. Thus, it is more effective as resolution goes up.

[0197] Drawing 163 is drawing showing the pattern of the black matrix (BM) of the 41st example. As mentioned above, leakage light arises in the part of a domain regulation means. As mentioned above, although using the very small domain where 90-degree azimuths which exist near the summit of a projection differ is also

considered, when stable orientation is not obtained near the summit of a projection, leakage light arises. Therefore, in order to improve contrast etc., it is desirable to shade the part of a domain regulation means. Although it is possible to form a projection with a protection-from-light ingredient in order to shade the part of a projection, the 41st example shades the part of a domain regulation means by the black matrix (BM).
[0198] As mentioned above, although BM34 is used in order to shade the leakage light of the boundary part of TFT and a cel electrode, and a bus line, in the 41st example, this BM is prepared also in the part of a domain regulation means. Thereby, the leakage light in the part of a domain regulation means can be shaded, and contrast improves. Drawing 164 is a sectional view of the panel of the 41st example. Like illustration, BM34 is formed corresponding to the clearance between Projections 20A and 20B, TFT33, and a bus line (here, only the gate bus line 31 is shown.) and the cel electrode 13.
[0199] Drawing 165 is the pixel pattern of the 42nd example. The delta array which makes a display pixel a square mostly, and the array pitch of a display pixel shifts 1/2, and arranges the display pixel of the adjoining train from the former is known. In the case of a color liquid crystal display, 1 set of color pixel groups are formed by three pixels 13B, 13G, and 13R which adjoin mutually. Since each pixel is a form near a square, even if it does not make the gap of a projection not much small compared with the case of the rectangle of 1 to 3, it becomes easy to make equal the rate of the liquid crystal molecule by which orientation division is carried out at least in all directions. In this case, it is made for a data bus line to extend in zigzag along the periphery of a pixel. Thus, a delta array is very effective, when forming the train of the projection which continued all over the substrate, or a hollow and carrying out orientation division.
[0200] The 43rd example explained below is an example which uses as a spacer the projection 77 which functions as the projection for orientation control, or a black matrix of the 40th example. A spacer is used in order to make distance between two substrates (cel thickness) into a predetermined value, as shown also in drawing 18. Drawing 166 is drawing showing the panel structure in the conventional example, and a spacer 45 is arranged at the boundary part of a pixel, and it specifies cel thickness. A spacer 45 is a ball which has a predetermined diameter.
[0201] Drawing 167 is drawing showing the panel structure of the 43rd example, and, as for (2), (1) shows the modification for the panel structure of the 43rd example. As shown in (1) of drawing 167, by the panel of the 43rd example, the projection 79 prepared in the periphery of a pixel is thickened to cel thickness, and projection 79 prescribes cel thickness. In addition, in this drawing, although the projection 79 is formed in the TFT substrate 17 side, it may be formed in the CF substrate 16 side. It becomes unnecessary thus, to form a spacer by constituting. In addition, since liquid crystal does not exist in the part of this projection 79, case [like a perpendicular orientation mold], a projection part (a part for a cel attaching part) always serves as a black display regardless of applied voltage. Therefore, a black matrix is unnecessary, it is not necessary to form projection 79 with the ingredient which has protection-from-light nature, and it may be made from a transparent ingredient.
[0202] In the 43rd example shown in (1) of drawing 167, although the projection 79 had prescribed cel thickness, the precision of cel thickness is influenced in the formation precision of a projection, and precision falls compared with the case where a spacer is used. The variation in cel thickness is controllable within **0.1 micrometers, as a result of actually manufacturing a panel in the form of the 16th example, if it is this level, especially in the present condition, it will not become a problem, but it is not suitable when strict cel thickness needs to be controlled. The modification shown in (2) of drawing 167 is the structure for solving such a problem. In the modification of (2) of drawing 167, into the resin which forms projection 80, a spacer 45 is mixed and applied, patterning of it is carried out, and a projection is formed. Although the advantage of the 43rd example that a spacer is unnecessary is lost in this modification, there is an advantage that cel thickness can be specified without being influenced by the formation precision of a projection pattern. Cel thickness was able to be made into the precision of **0.05 micrometers as a result of actually manufacturing a panel in the form of (2) of drawing 167. Moreover, although it is unchanging for needing a spacer, in order to make a spacer mix in resin and to arrange a spacer on a cel to the resin and coincidence of a projection, it is not necessary to sprinkle a spacer to a panel chemically-modified degree anew, and a process does not increase.
[0203] Drawing 168 is also drawing showing the modification of the 43rd example, (1) is what considered the projection 79 in the 43rd example of (1) of drawing 167 as the projection 81 which made from the ingredient of protection-from-light nature, and (2) considers the projection 80 of drawing 167 of (2) as the projection 82 made from the ingredient of protection-from-light nature. As mentioned above, in (1) of drawing 167, and (2),

although these projections fully achieve the function of a black matrix even if it forms projection 79 or 80 by the transparent material, protection-from-light nature with more perfect forming this with a protection-from-light ingredient is obtained.

[0204] It is drawing showing the modification of the 43rd example, and the projection 83 was formed in the CF substrate 16, and drawing 169 also formed the projection 84 in the TFT substrate 17, respectively, and has specified cel thickness by contacting them. About effectiveness, it is the same as the 43rd example and its modification. Although the projection prepared in the periphery of a pixel has prescribed cel thickness in the 43rd example and its modification, it is also possible to specify cel thickness by the projection for orientation control, for example, projection 20of drawing 162 A.

[0205] Furthermore, although the projection was formed over all the peripheries of a pixel in the modification of the 40th example, the 43rd example, and the 43rd example, it is also possible to form a projection in a part of periphery of a pixel. For example, the projections 77, 79-84 of the modification of the 40th example, the 43rd example, and the 43rd example are formed in the TFT part of each pixel, i.e., the part shown with the reference number 78 of drawing 162, with the ingredient of protection-from-light nature. as mentioned above , VA (Vertically Aligned) even if it omit a black matrix by the so-called panel in the normally black mode which display black when the electrical potential difference have not join an ITO electrode like a method , since it hardly become a problem , if only the part of TFT cover by the resin of protection from light nature and it make not prepare on the drain bus of a pixel periphery , and a gate bus , the numerical aperture of leakage light improve so much , and it be advantageous as above-mentioned , if the protection from light section decrease .

[0206] In the 43rd example, although the function of a spacer was given to the black matrix, in giving the function of a spacer to neither a black matrix nor a projection, after while having formed the perpendicular orientation film and sprinkling as usual the spherical spacer which has a diameter equal to a substrate to cel thickness, the substrate of another side will be stuck. However, when a projection is formed on an electrode, some sprinkled spacers will be located on a projection. If the diameter of a spacer is made equal to cel thickness in case there is no projection, cel thickness will become larger than a desired value for the spacer which gets on a projection. Furthermore, the force joins the once assembled panel from the exterior, in [a spacer projecting], cel thickness becomes [the part] large with ******, and problems, such as display unevenness, arise. It is made for such a problem not to arise by reducing the diameter of a spacer beforehand in consideration of the thickness of a projection in the 44th example explained below.

[0207] Drawing 170 is drawing showing the panel structure of the 44th example, and shows the condition that (1) assembled, (2) assembled the front TFT substrate 17, and (3) assembled the front CF substrate 16. Projection 20A is formed on the electrode 12 of the CF substrate 16, the perpendicular orientation film 22 is formed further, projection 20B is formed on the electrode 13 of the TFT substrate 17, and the perpendicular orientation film 22 is further formed as shown in (1) of drawing 170, and (2). Projections 20A and 20B are 1 micrometer in the same height, and when it sees from a panel side, they are assembled so that it may not cross mutually. Cel thickness is 4 micrometers and the diameter of the spacer 85 made from plastics is 3 micrometers which subtracted the height of a projection from cel thickness. it is shown in (1) of drawing 170 -- as -- the TFT substrate 17 -- a spacer 85 -- 150-300 piece/mm2 It sprinkles. a seal is formed in the CF substrate 16 with the resin made from adhesion, and it sticks [it is alike and] on the TFT substrate 17. As shown in (3), a spacer 85 is located on projection 20B or under 20A by a certain probability. This probability is the whole area of the part of Projections 20A and 20B rate of. If it is in the condition of (3), cel thickness will be regulated by the thickness of the spacer located on projection 20B or under 20A, and a projection. The spacer 45 in parts other than projection 20A and 20B turns into a suspension spacer which does not influence cel thickness. Since cel thickness is regulated by Projections 20A and 20B, cel thickness hardly becomes larger than a desired value. Moreover, even if spacers other than the part of a projection during use of a panel move to the part of a projection, cel thickness does not become thick, and even if the spacer which suited the projection part moves to parts other than a projection, it only becomes a suspension spacer.

[0208] Drawing 171 is drawing showing the spraying consistency of a spacer, and the relation of cel thickness. It is the spraying consistency of a spacer 100-500 pieces/mm 2 Then, cel thickness serves as the range of 4micrometer**0.5micrometer. Next, the unevenness of cel thickness and the experimental result of the spraying consistency of a spacer which are generated when the force is applied to a panel from the exterior are shown in drawing 172. This result to a spraying consistency is 2 150 pieces/mm. Below, it is easy to generate unevenness to force application, and is 2 300 pieces/mm. Above, it is easy to generate unevenness to hauling. Therefore, a

spraying consistency is 2 150-300 pieces/mm. It is the optimal.
[0209] By the production process of a liquid crystal display panel, an ionicity impurity may be incorporated or the ion eluted from the ion and orientation film which are contained in liquid crystal, a projection formation ingredient, a sealant, etc. may mix into a liquid crystal panel. If ion mixes into a liquid crystal panel, in order for the specific resistance of a panel to fall, the effectual electrical potential difference impressed to a panel will fall, and it will become the cause which display unevenness generates. Moreover, mixing of ion also becomes the cause of generating printing of a display on a panel, and leads also to decline in electrical-potential-difference retention further. Thus, when ion mixes in a panel, the display quality and dependability of a liquid crystal panel will fall.
[0210] Therefore, it is desirable to prepare the ion adsorption capacity force in the projection of the dielectric formed on the electrode used as a domain regulation means explained in the old example. In order to give the ion adsorption capacity force, there are two approaches. One is irradiating ultraviolet rays and another side is adding the ingredient which has the ion adsorption capacity force into the ingredient of a projection. If ultraviolet rays are irradiated, since the surface energy of a projection formation ingredient will go up, the ion adsorption capacity force is heightened. Surface energy gamma is expressed with the sum of polar term gammap of surface energy, and distributed term gammad of surface energy. A polar term is based on coulomb electrostatic force, and a distributed term is based on the dispersion force of the Van der Waals force. If ultraviolet rays are irradiated, cutting of association of the low part of binding energy will break out, and the cut part and the oxygen in air will join together. By that cause, surface polarizability increases, a polar term becomes large, and surface energy increases. If the degree of polarization increases, ion will become that a front face is easy to adsorb. That is, a projection front face comes to have the ion adsorption capacity force by irradiating ultraviolet rays. In case ultraviolet rays are irradiated, it is desirable to irradiate only a projection alternatively, but since association of a projection formation ingredient tends to go out rather than association on the front face of a substrate, even if it irradiates ultraviolet rays all over a panel, only a projection comes to have the ion adsorption capacity force. After irradiating ultraviolet rays, the perpendicular orientation film is formed.
[0211] As an ingredient which has the ion adsorption capacity force, ion exchange resin, a chelating agent, a silane coupling agent, silica gel, the alumina, the zeolite, etc. are known. Among these, ion exchange resin exchanges ion, and although it supplements with the ion which existed from the beginning as an impurity instead, it is not suitable [ion exchange resin] for adding into a projection formation ingredient in order to emit another ion. Since the ingredient which has the capacity supplementary to ion exists in the ingredient which has the chelate organization potency force, without emitting another ion, it is desirable to use such an ingredient. As such an ingredient, there are crown ether as shows a chemical formula in drawing 173, and cryptand as show a chemical formula in drawing 174. Furthermore, it has the capacity supplementary to ion, without inorganic materials, such as an alumina and a zeolite, also emitting ion. Therefore, these ingredients are used. In addition, since a limitation is in the class of ion adsorbed only with one ion adsorption ingredient, it is good to use it combining the ingredient which adsorbs different ion.
[0212] The result of having formed the projection train whose height the gap between 1.5micro and a projection is width of face of 7.5 micrometers, and is 15 micrometers by the positive resist, having performed processing which gives various kinds of above-mentioned ion adsorption capacity force, and having measured early ion density and the ion density (unit pc) after using it for 200 hours by the manufactured panel is shown in drawing 253. In drawing 253, the ultraviolet rays of 1500mJ(s) were irradiated in Example C, 0.5 percentage by weight of crown ether was added in Example D, the zeolite was added in Example E, and crown ether and a zeolite were added in Example F. In addition, the case where processing which gives the ion adsorption capacity force for reference is not performed is shown as an example of a comparison. Impressing the 0.1Hz triangular wave of 10V at the time of use, the temperature at the time of measurement is 50-degreeC. The initial value of ion density is the almost same level irrespective of the existence of this result to ion adsorption capacity force processing. However, the ion density of 200 hours after is increasing sharply, when not processing, but if it processes, it is understood that there are few increments.
[0213] Moreover, although printing occurred when the running trial of what irradiated ultraviolet rays, and the thing which does not process at all was actually carried out for 500 hours, and not processing, printing was not generated in what irradiated ultraviolet rays. Although the configuration which forms the near projection pattern of the CF substrate 16 by the black matrix is indicated in the 40th example, it explains in more detail about this.

[0214] As mentioned above, if a projection pattern can be formed in the CF substrate 16 using the conventional process, since a new process will not be added, the increment in cost for formation of a projection pattern can be suppressed to the minimum. The 45th example is an example which forms a projection pattern in the CF substrate 16 using the conventional process. Drawing 175 is drawing showing the structure of CF substrate of the 45th example. As shown in (1) of drawing 175, in the 45th example, color filter resin (CF resin) 39R and 39G (otherwise, it is 39B) is formed for every pixel on the CF substrate 16. And on it, with suitable ingredients, such as a black matrix, CF resin, and other flattening resin, projection turn 50A is formed at a position, and ITO (transparent electrode) 12 is formed on it. Although especially the ingredient of a black matrix is not limited, in order to form a projection, a certain amount of thickness is required, and it is desirable to use resin, when it is taken into consideration.
[0215] (2) of drawing 175 is drawing showing the modification of CF substrate of the 45th example, on the CF substrate 16, is suitable ingredients, such as a black matrix, CF resin, and other flattening resin, and forms projection turn 50B at a position. Then, if CF resin 39R and 39G is formed, since CF resin laps, the part of a projection will become thick and will be projecting as it is. ITO(transparent electrode) 12 is formed in this.
[0216] A projection can be formed in any location of CF substrate if it is the structure of the 45th example. Drawing 176 is drawing showing the panel structure of the 46th example. In the 46th example, projection 50 is formed in the part of the joint of the black matrix, Periphery 39R, 39G, and 39B, i.e., CF resin, of a pixel of the CF substrate 16, 34, and projection 20B is formed in the TFT substrate 17 in the middle of this joint. Therefore, in forming the projection which continued on the side of the lot which the joint of each pixel counters with the CF substrate 16, i.e., a straight-line-like projection pattern, it forms the straight-line-like projection pattern which is parallel to this projection pattern near the core of the pixel of a TFT substrate. Moreover, since it becomes a pattern as shown in drawing 80 and drawing 81 when forming the projection which continued on all the sides of the joint of each pixel with the CF substrate 16, a square drill-like projection is formed near the core of a pixel at the TFT substrate 17.
[0217] If it is the panel structure of the 46th example, various modes are possible for the structure. Hereafter, the example of the structure of CF substrate of the 46th example is explained. Drawing 177 to the drawing 182 is drawing showing the example of structure of CF substrate of the 46th example. In (1) of drawing 177, the black matrix (BM) 34 is established between CF resin 39R and 39G, BM34 is formed more thickly than CF resin, and the ITO electrode 12 is formed on it. The part of BM34 is projecting. It is desirable to form BM34 by resin etc. also in this case.
[0218] In (2) of drawing 177, after forming thin BM34 with a metal etc. on the CF substrate 12 and forming a color filter by CF resin 39R and 39G on it, projection 70 is further formed by CF resin 39R, and the ITO electrode 12 is formed further. In (1) of drawing 178, after forming thin BM34 with a metal etc. on the CF substrate 12 and forming a color filter by CF resin 39R and 39G on it, projection 71 is formed with resin other than BM34 and CF resin, for example, the resin used for flattening material, and the ITO electrode 12 is formed further. In this case, flattening material is formed like (1) of drawing 177 more thickly than CF resin.
[0219] In (2) of drawing 178, after forming BM34 for thickness of a projection by resin etc. on the CF substrate 12, and forming a color filter by CF resin 39R and 39G so that it may lap with BM34, the ITO electrode 12 is formed further. The part of CF resin which laps with BM34 is projecting. In (1) of drawing 179, after forming thin BM34 with a metal etc. on the CF substrate 12 and forming CF resin 39R on it, CF resin 39G are formed so that it may lap with CF resin 39R, and the ITO electrode 12 is formed further. The part with which CF resin laps is projecting. Since there is BM34 in the part of a projection and light is not passed, which color filter resin may be a top. If it is this structure, since a projection can be formed at the process which forms a color filter, a process does not increase.
[0220] By (1) of drawing 177, it forms (2) of drawing 179 so that a part of CF resin 39R and 39G may lap with the flattening material 71. The part to which CF resin laps with the flattening material 71 is projecting. Thereby, the flattening material 71 can be made thin to a part for the height of a projection. The above structure forms an ITO electrode after a projection, and although it is structure which has a projection in an electrode, it explains the example which forms a projection by the insulating material on an ITO electrode next.
[0221] In drawing 180, after forming a color filter in the CF substrate 16 by CF resin 39R and 39G, the ITO electrode 12 is formed further and a projection is formed by BM34 on it. A process does not increase in this case, either. In (1) of drawing 181, after forming thin BM34 in the CF substrate 16, the ITO electrode 12 is formed and a color filter is formed by CF resin 39R and 39G on it. CF resin 39R and 39G is considered as a

projection in piles in that case. A process does not increase in this case, either.
[0222] In (2) of drawing 181, after forming thin BM34 in the CF substrate 16, a color filter is formed by CF resin 39R and 39G, the ITO electrode 12 is formed further, and projection 50E is formed by flattening material on it. In (1) of drawing 182, after forming the ITO electrode 12 in the CF substrate 16, a color filter is formed by CF resin 39R and 39G on it, and a projection is formed by BM34.
[0223] In (2) of drawing 182, after forming thin BM34 in the CF substrate 16, a color filter is formed by CF resin 39R and 39G on it, and flattening material 50F front face is made flat. The ITO electrode 12 is formed on it, BM34 is formed further, and it considers as a projection. Drawing 183 and drawing 184 are drawings explaining the production process of the color filter (CF) substrate in the 47th example. This CF substrate has a projection as a domain regulation means.
[0224] As shown in (1) of drawing 183, a glass substrate 16 is prepared. Next, as shown in (2), 1.3 micrometers resin (B resin: CBmade from the Fuji hunt- 7001) 39B' for filters of CF of a negative mold for blue is applied on a glass substrate 16. As shown in (3), an B resin is formed in the parts of a blue (B) picture element part, the BM section, and projection 20A by the photolithography method which used a photo mask 370 like illustration. Next, as shown in (4), resin (R resin: CRmade from the Fuji hunt- 7001) 39R' for filters for red is applied, and R resin is formed in the parts of a red (R) picture element part, the BM section, and projection 20A by the photolithography method which used the photo mask 371. Furthermore, as shown in (5), resin (G resin: CGmade from the Fuji hunt- 7001) 39G' for filters for Green is applied, and G resin is formed in the parts of the Green (G) picture element part, the BM section, and projection 20A by the photolithography method which used the photo mask 372. According to the above process, only one layer of three layers of resin of B, G, and R laps with BM section and projection 20A, and the color filter (CF) resin corresponding to each picture element part of B, G, and R is formed. The part with which three layers of resin of B, G, and R lapped turns into a part for Kurobe which hardly penetrates light. Next, about 1.5 micrometers (Hitachi Chemical make: H.P.-1009) of transparence flattening resin are applied by the spin coater, and after carrying out post baking in the oven of 230-degreeC for 1 hour, the ITO film is formed by the mask spatter. Next, they are the ultraviolet rays which prebake a black positive resist (Tokyo adaptation make : CFPR-BKP) after about 1.0 - 1.5-micrometer spreading by the spin coater, let CF resin pass from the tooth back of a glass substrate 16, and contain the wavelength of 365nm as shown in (6) 1000 mJ/cm2 It exposes. Since the permeability of ultraviolet rays is low compared with other parts, the part with which three layers of resin of B, G, and R lapped does not reach the threshold of exposure. And if negatives are developed with an alkali developer, since the BM section 34 and projection 20A which were not exposed will be formed, post baking is carried out in the oven of 230-degreeC for 1 hour. Furthermore, the perpendicular orientation film 22 is formed and CF substrate is completed.
[0225] Drawing 185 is a sectional view of the liquid crystal panel which stuck the CF substrate 16 and the TFT substrate 17 which were manufactured as mentioned above, and was completed. The slit 21 is formed in the TFT substrate 17 as a domain regulation means at the pixel electrode 13, and the perpendicular orientation film 22 is formed on it. Reference numbers 40 are a gate protective coat and a channel protective coat. In addition, BM34 and the resin, B, G, and R, of three layers have lapped with the part to be shaded, and protection-from-light nature is good. Moreover, projection 20A of the CF substrate 16 and the slit 21 of the TFT substrate 17 divide the orientation of liquid crystal, and a good viewing-angle property and a high working speed are obtained.
[0226] In the 47th example, as explained above, since it is not necessary to perform pattern exposure and pattern NINGU can be carried out by tooth-back exposure when forming projection 20A which is the domain regulation means of CF substrate, and BM34, projection 20A and the formation process of BM34 become easy, cost is reduced, and the yield improves. In addition, in the 47th example, although the pigment-content powder method is used for formation of CF, when forming a staining technique and the nonphotosensitivity resist which is making polyimide etc. distribute a pigment by etching, it can apply similarly. Moreover, although three layers of CF resin were put on projection 20A and the part of BM34 in the 47th example, two-layer is possible if the wavelength and exposure energy of exposure light at the time of tooth-back exposure are chosen suitably.
[0227] Although the projection which is a domain regulation means was formed in CF substrate without pattern NINGU with BM in the 47th example, also when forming only BM, without forming a projection, naturally it can apply. A projection is an example which forms BM, without forming by the approach as the 47th example that the 48th example is the same. Drawing 186 is drawing explaining the production process of CF substrate in the 48th example, and drawing 187 is drawing showing the panel structure of the 48th example.

[0228] The 48th example forms the BM projection 381 only in the part corresponding to BM for CF resin in piles, without putting CF resin on the part corresponding to a projection. Next, without carrying out, as shown in (1) of drawing 186, flattening forms the ITO film 12 and applies about 2.0 micrometers - the 2.5 micrometers of the above-mentioned black positives resist 380 in predetermined thickness, for example. By carrying out tooth-back exposure on it, and developing negatives, the panel which piled up the BM resist 380 after the BM projection 381 as shown in (2) of drawing 186 is obtained. BM is made by both the BM projection 381 and the BM resist 380.
[0229] A panel as stuck such a CF substrate and a TFT substrate and shown in (1) of drawing 187 is manufactured. (2) of drawing 187 is the enlarged drawing of the circular parts of the dotted line of (1), and the BM resist 380 touches the TFT substrate 17, and it has specified the distance between substrates by both the BM projection 381 and the BM resist 380. That is, the BM projection 381 and the BM resist 380 have played the role of a spacer.
[0230] As explained above, in order for BM to play the role of a spacer, in the 48th example, it is not necessary to form a spacer, when it is not necessary to carry out pattern NINGU of the BM and a process becomes easy. In addition, although BM was formed in the 48th example, without carrying out pattern NINGU by tooth-back exposure using a positive resist, as long as it carries out pattern NINGU by the photolithography method, the resist of both a negative mold and a positive type may be used. Moreover, since the projection which is a domain regulation means, and work of a spacer are naturally carried out even if not black, it is effective also in the 47th example.
[0231] Next, the example which uses as BM the projection 381 which piled up CF resin in the 48th example as it is is explained. Drawing 188 is drawing explaining the production process of CF substrate in the 48th example, and drawing 189 is drawing showing the panel structure of the 48th example. As shown in (1) of drawing 188, the projection 381 which hardly penetrates three layers of light for CF resin in piles into the part of BM is formed. Next, as shown in (2), after applying about 1.5 micrometers of the above-mentioned transparence flattening resin by the spin coater and carrying out postbake by 230-degreeC for 1 hour, the ITO film 12 is formed. Furthermore, as shown in (3), about 1.0-1.5 micrometers (SHIPUREI Far East company make: SC-1811) of positives resist are applied, and projection 20A is formed by the photolithography method after prebaking. Since the projection 381 which piled up three layers of CF resin of B, G, and R hardly penetrates light, it acts as BM. Thus, by sticking the completed CF substrate 16 through the TFT substrate 16 and a spacer 45, a panel as shown in drawing 189 is completed.
[0232] Although the 49th example explained the example which forms BM for CF resin in piles from the 47th example, the liquid crystal display of VA method which pinches negative-mold liquid crystal is a normally black, and the non-picture element part to which an electrical potential difference is not impressed hardly penetrates light. Therefore, in the case of a normally white, BM which shades a non-picture element part can also use the thing of light transmittance which becomes a problem. That is, it can be said that BM should just be to some extent low light transmittance. The 50th example is an example which simplifies manufacture of CF substrate paying attention to such a point, and uses an B resin for one CF resin and a concrete target as BM. This does not produce a problem as display quality, either.
[0233] Drawing 190 is drawing explaining the production process of CF substrate in the 50th example, and drawing 191 is drawing showing the panel structure of the 50th example. As shown in drawing 190, they are R and G (the Fuji hunt company make: CR-7001, CG-7001) on a glass substrate 16. Negative-mold B photopolymer after forming CF resin of two colors (the Fuji hunt company make: CB-7001) It applies by the spin coater or the roll coater, and prebakes. Then, they are the ultraviolet rays which contain the wavelength of 365nm from the tooth back of a glass substrate 16 300 mJ/cm2 It exposes, negatives are developed with an alkali developer (the Fuji hunt company make: CD), and postbake is carried out in the oven of 230-degreeC for 1 hour. Then, the ITO film is formed and the perpendicular orientation film is formed further. That is, an B resin will be formed in addition to the part in which CF resin of R and G is formed. Therefore, an B resin will be formed in a part with the need of shading if it is made not to form CF resin of R and G in a part with the need of forming BM and shading.
[0234] As shown in (1) of drawing 191, B resin 39B is formed in the part of the bus lines 31 and 32 with the need of shading, and the part of TFT, as BM. In addition, (2) of drawing 191 is drawing which expanded the circular parts of the dotted line of (1), and when sticking two substrates for the width of face of the CF side protection-from-light section (B resin) 382 shown by the arrow head on the width of face of the bus lines 31 and

32 of the TFT substrate 17 like illustration, it can also obtain a high numerical aperture by making it the width of face which added margin **.

[0235] In the 50th example, generally, since the permeability of g of sensitization wavelength, h, and i line was B resin >R resin >G resin, it formed the B resin at the end, but if CF resin with high (there is little light exposure and it is good) exposure sensibility and CF resin with high sensitization wavelength permeability are formed at the end, the resin remainder of the last formation color is hard to generate and is effective on the already formed resin. Furthermore, it is also effective to form an alignment mark in the Isshiki eye with a pixel pattern using the color (generally [in the transmitted light] B>R>G) resin which the location alignment mark of an aligner tends to identify.

[0236] Drawing 192 is drawing showing the structure of CF substrate of the 51st example. In the conventional liquid crystal display, BM34 of a metal membrane was formed on the glass substrate 16, CF resin was formed on it, and the ITO film was further formed on it. On the other hand, in the 51st example, BM is formed on the ITO film. In the 51st example, like the example explained until now, pattern NINGU of the CF resin 39 is carried out, and it is formed on a glass substrate 16. Transparence flattening material may be applied if needed. Next, the transparent ITO film 12 is formed and a light-shielding film 383 is formed in the part of illustration on it. For example, the spatter of about 0.1 micrometers of the ITO film 12 is carried out through a mask, and about 0.1 micrometers of Cr(s) are formed as a light-shielding film layer on it. Furthermore, on a light-shielding film layer, a resist is applied to homogeneity by the methods of application, such as a spin coat method, about 1.5 micrometers in thickness, exposure of the pattern of a light-shielding film, development, etching, and exfoliation are performed, and a light-shielding film 383 is formed. A light-shielding film 383 is conductivity in Cr, and since a touch area with the ITO film 12 is also large, it is effective in making low resistance of the ITO film 12 in the whole substrate. In addition, formation of the ITO film 12 or a light-shielding film 383 may be performed by what kind of approach. For example, if it is the conventional approach, after membrane formation of the ITO film 12, it will anneal, substrate washing will be performed, Cr film will be formed, but in the 51st example, since it becomes possible to perform membrane formation of the ITO film 12 and Cr film continuously within 1 equipment and it can reduce washing processes, a process can be simplified. Therefore, membrane formation equipments can be reduced and equipment can also be made small.

[0237] Drawing 193 is drawing showing the modification of CF substrate of the 51st example. In (1) of drawing 193, after forming three CF resin and forming another resin 384 in the slot of the boundary section of CF resin, the ITO film 12 and a light-shielding film 383 are formed. In (2) of drawing 193, like the 50th example explained in drawing 190, after forming two CF resin 39R and 39G, about 1.5 micrometers of B resins were applied, tooth-back exposure was carried out, negatives were developed, and the flat front face was formed. The ITO film 12 and a light-shielding film 383 are formed on it. If it is this, since the front face of CF layer is flat, an open circuit of the ITO film will be lost and resistance of the ITO film 12 in the whole substrate can be further made low.

[0238] In addition, if the low coloring resin of a reflection factor is used as the resin 384 under a light-shielding film 383, or 39B, it is possible for the reflection factor of the protection-from-light section to become low, and to carry out reflection of the outdoor daylight of a liquid crystal display to low reflection more. Furthermore, if the low coloring resin of permeability is used as the resin 384 under a light-shielding film 383, or 39B, it is possible for the permeability of the protection-from-light section to become low, and to form a liquid crystal display into high contrast.

[0239] Moreover, since it is not necessary to carry out pattern NINGU when forming CF resin 34B if it is the structure of (2) of drawing 193, it becomes unnecessary to use the aligner in which that much expensive pattern NINGU is possible, plant-and-equipment investment can be lessened, and cost can also be reduced. Drawing 194 is drawing showing the modification of the 51st example, and a spacer 45 is formed on the light-shielding film formed in the configuration of arbitration after pattern NINGU of a resist by mixing the spacer which controls the thickness of a liquid crystal layer beforehand in the resist applied on a light-shielding film. Thereby, the spraying process of a spacer becomes unnecessary.

[0240] Drawing 195 is drawing showing CF substrate of the modification of the 51st example. In this example, in the 51st example, when carrying out pattern NINGU of the light-shielding film 383 and exposing it after forming Cr on the ITO film 12 and applying a resist on it, pattern NINGU also of the part of a projection which works as a domain regulation means is carried out together. And after performing development and etching, it does not exfoliate but leaves a resist as it is. Thereby, the insulating projection 387 which works as a domain

regulation means is formed in the CF substrate 16. Such a CF substrate is used and the panel of structure as shown in drawing 196 is realized.

[0241] As the 47th example etc. explained, after having applied flattening agents, such as acrylic resin, after forming CF layer, and making a front face flat, the electrode 12 of the ITO film was formed with the CF substrate 16. However, this process may be skipped for simplification of a process. What does not have a layer for such flattening is called CF substrate without topcoat. The following problems will be produced if an electrode 12 is formed without topcoat. Since a hollow is generated into the part between each CF and an anisotropy is towards a spatter when sputtering of the ITO film is carried out, the ITO film will be attached to the part of the hollow between each CF to the ITO film being densely attached to the flat part of each CF at base. For this reason, on the ITO film attached to the part of a hollow, the bigger clearance than the ITO film of a flat part will have opened.

[0242] For this reason, when applying or printing the perpendicular orientation film on CF substrate, the solvent which will be contained in the orientation film by the time it performs PURIKYUA (BEKU) after spreading/printing enters into CF layer from the part of a slot. Even if the solvent which entered prebakes, after remaining in the interior and assembling it, it comes out, and it makes an orientation film front face produce a crater etc. If a crater arises, display unevenness will occur. if protection-from-light layers, such as chromium, are prepared in the slot between each CF like the 51st example -- thereby -- CF layer of the solvent of the orientation film -- entering -- it can prevent now. In the 52nd example explained below, in order to prevent the enter lump by CF layer of the solvent of the orientation film, the resin prepared in the slot between each CF is used as a projection.

[0243] Drawing 254 is drawing showing the manufacture approach of CF substrate of the modification of the 51st example. (1) is CF substrate without topcoat, each CF layer of RGB is formed, the light-shielding film 34 is formed in the bottom of a boundary part, and, upwards, the ITO film 12 for electrodes is formed. POJIFOTOREJISUTO 389 is applied as shown in (2). As shown in (3), ultraviolet rays are irradiated from a glass substrate side, and if negatives are developed, projection 390 will be formed in the part of a light-shielding film 34 as shown in (4). Projection 390 prevents permeation in CF layer of a solvent at the time of spreading of the perpendicular orientation film. Furthermore, after being assembled, it functions as projection 20A by the side of CF substrate formed in the boundary of a pixel.

[0244] In the above, although the panel structure of the liquid crystal display of this invention was explained, the application suitable for such a panel is explained. Drawing 197 is the example of the product which used the liquid crystal display of this invention, and drawing 198 is drawing showing the configuration of this product. As shown in drawing 198, as explained until now, there is the screen 111 in a liquid crystal panel 100, and a viewing-angle property is good, and the image displayed also from the big direction to which it inclined the degree of angle can be seen in good quality only from a transverse plane, without producing tone reversal by high contrast. Behind the liquid crystal panel 100, the transilluminator 113 for making the illumination light from the light source 114 and the light source 114 into the light which illuminates a liquid crystal panel 110 uniformly is formed.

[0245] As shown in drawing 197, the part of the display screen 110 is pivotable and it can be used also as a display of a vertical mold also as a display of a horizontal type with this product according to an application. For this reason, it switches whether the switch which detects having leaned 45 degrees or more is formed, the condition of this switch is detected, and it displays as a display of a horizontal type, or it displays as a display of a vertical mold. In order to perform such a switch, the device in which read-out of the indicative data from the frame memory for image display is performed from a direction different 90 degrees etc. is required, but since the technique for it is known widely, explanation is omitted here.

[0246] The advantage at the time of applying the liquid crystal display of this invention to such a product is explained. In the conventional liquid crystal display, since an angle of visibility was narrow, when it was made the big display screen, the angle of visibility to a periphery became large, and the problem that a periphery was hard to see had produced it. However, since the display of high contrast is in sight also in a big viewing angle as for the liquid crystal display which applied this invention, without gradation being reversed, such a problem does not produce it. With a product as shown in drawing 197, an angle of visibility becomes large to a periphery with the longer display screen. Therefore, although the liquid crystal display was not able to be used for such a product, if it is the liquid crystal display of this invention, since the angle of visibility is large, it is fully applicable.

[0247] Although the example explained until now showed the equipment which mainly divides orientation into two fields to which bearings differ by a unit of 90 degrees with four fields where every 90 degrees of bearings differ, the case where these are applied to this invention is considered. Since a viewing-angle property almost good about all the directions is acquired when orientation is divided into four fields to which every 90 degrees of bearings differ, especially a problem is not produced even if it sets the direction of orientation as any. For example, as the projection pattern shown in drawing 46 is shown in (1) of drawing 199 to a screen, when it has arranged, since a longitudinal direction and the vertical direction are 80 degrees or more, they rotate the viewing angle a display looks good, and especially a problem is not produced even if a projection pattern becomes like [on the right of drawing].

[0248] On the other hand, although the viewing-angle property of the direction which carried out orientation division improves when orientation is divided into two fields to which 180-degree bearings differ, as for a direction which is different 90 degrees in it, a viewing-angle property is seldom improved. Therefore, when a viewing-angle property almost equal to a longitudinal direction and the vertical direction is required, as shown in (2) of drawing 199, it is desirable to run a projection pattern in the direction of slanting on a screen.

[0249] Next, the production process of the liquid crystal display of this invention is explained briefly. Generally, as shown in drawing 200, the washing process 501 of a substrate, the gate electrode formation process 502, the layer continuation film formation process 503 of operation, the isolation process 504, the protective coat formation process 505, the pixel electrode formation process 506, and an assembler are performed in order of 508, but the production process of a liquid crystal panel will form the projection formation process 507 after the pixel electrode formation process 506, if an insulating projection is formed.

[0250] As shown in drawing 201, a projection formation process consists of the resist spreading process 511, the prebaking process 512 which calcinates the applied resist, a projection pattern exposure process 513 exposed so that it may leave the part of a projection, a development process 514 which removes parts other than a projection, and a postbake process 215 which calcinates the projection which remained. As the 1st example explained, it is desirable for there to be possibility that a resist will react with the orientation film with the orientation film formation process performed at a next process, and to calcinate at an elevated temperature to some extent in consideration of it in the postbake process 515. In that case, if the cross section of a projection inclines in the shape of boiled fish paste, the stability of orientation will also increase.

[0251] Also when forming a hollow as a domain regulation means, it is carried out at the almost same process, but since what is necessary is just to form a pattern which prepares a slit in a pixel electrode with the pixel electrode formation process 506 of drawing 200 in forming a slit in an electrode, the projection formation process 507 becomes unnecessary. Having been shown in drawing 201 can also form a projection pattern by printing, although it is an example in the case of forming a projection pattern by the photosensitive resist. Drawing 202 is drawing showing how to form a projection pattern in Toppan Printing. As shown in drawing 202, a projection pattern is formed in the flexible letterpress 604 made of APR resin, and this is fixed to the front face of the big roll 603 called a printing cylinder. A printing cylinder is interlocked with the ANIKKUSU roll 605, a doctor roll 606, and the printing stage 602, and is rotated. If the polyimide resin solution for projection formation is dropped on the ANIKKUSU roll 605 by the dispenser 607, it will be extended by the doctor roll 606 and the solution which the resin solution developed and developed by homogeneity on the ANIKKUSU roll 605 was imprinted by letterpress 604, and was imprinted by the heights of letterpress 604 will be imprinted by the substrate 609 on the printing stage 602. Then, baking etc. is processed. If various utilization is carried out and the approach of forming a pattern minute otherwise by printing can form a projection pattern using them, a projection pattern can be formed by low cost.

[0252] Next, impregnation processing of the liquid crystal to the liquid crystal panel after sticking a vertical substrate is explained. Although liquid crystal is poured in after sticking CF substrate and a TFT substrate like the assembler of a liquid crystal panel, as drawing 18 explained, LCD of a VA mold TFT method has narrow cel thickness, although the time amount of liquid crystal impregnation becomes long, in order to prepare a projection, the time amount of liquid crystal impregnation is long, and to shorten time amount of liquid crystal impregnation as much as possible is desired.

[0253] Drawing 203 is drawing showing the configuration of a liquid crystal injection injector. Although detailed explanation of this equipment is omitted, the impregnation connector 615 is connected to the liquid crystal inlet of a liquid crystal panel 100, and liquid crystal is supplied from the liquid crystal degassing pressure tank 614. The exhaust air connector 618 is connected to it and coincidence for the exhaust port of

liquid crystal, the inside of a liquid crystal panel 100 is decompressed with the vacuum pump 620 for exhaust air, and liquid crystal makes it be easy to be poured in. The liquid crystal discharged from an exhaust port is separated with a gas by the liquid crystal trap 619.

[0254] In the 1st example, as shown in drawing 18, projection 20 is a straight line-like and was running in the direction parallel to the long side of a panel 100. Therefore, the inlet 102 of liquid crystal was established in the shorter side of a panel perpendicular to projection 20, and the exhaust port 103 was established in the shorter side of that an inlet 102 is formed and the opposite side. As shown in (1) of drawing 204, and (2), when similarly the projection 20 is running in the direction parallel to the shorter side of a panel 100 by the shape of a straight line, the inlet 102 of liquid crystal is established in the long side of a panel perpendicular to projection 20, and, as for an exhaust port 103, it is desirable to prepare in the long side of that an inlet 102 is formed and the opposite side. Moreover, also when projection 20 is zigzag, as the inlet 102 of liquid crystal is established in the side of a panel perpendicular to the direction in which projection 20 is prolonged and it is shown in drawing 206, it is desirable [an exhaust port 103], as shown in drawing 205 to prepare in the side of that an inlet 102 is formed and the opposite side.

[0255] Here, a poor display will be caused, if air bubbles may mix at the time of impregnation of liquid crystal and air bubbles mix. When the liquid crystal and the perpendicular orientation film of a negative mold are used, it becomes a black display at the time of no electrical-potential-difference impressing, but even if air bubbles mix in liquid crystal, since the part becomes a black display, if it remains as it is, mixing of air bubbles cannot be discovered. Therefore, the electrical potential difference was impressed to the electrode, and it was made the white display, and was checking that air bubbles were not mixing because there is no part of a black display. However, since there was no electrode near the inlet of liquid crystal, even if air bubbles were mixed in this part, it was not able to discover. Since there is a possibility of it being spread someday and reducing display quality when air bubbles are in this part, it is necessary to also discover the air bubbles near an inlet. Then, an electrode 120 is formed also near [inlet 101] the outside of a viewing area 121 and the black matrix 34, and it enables it to detect mixing of air bubbles also in this part with the liquid crystal display of this invention, as shown in drawing 207.

[0256] Since the liquid crystal display of projection and become depressed and using domain regulation means, such as slit, VA method does not need to perform rubbing processing as explained until now, the contamination in a production process is reduced sharply. Therefore, there is an advantage that a part of washing process can be skipped. However, the problem of the resistance to contamination over the organic substance being weak compared with the positive type usually used, and it being especially weak to polyurethane system resin or the skin, and causing a poor display has produced the negative-mold (n mold) liquid crystal to be used. It is considered to be the cause that the specific resistance of the liquid crystal with which the poor display was polluted falls.

[0257] Then, when it was polyurethane system resin and the skin of what kind of magnitude first, it investigated whether it would become a poor display. Drawing 208 is the liquid crystal panel of VA method. After forming the perpendicular orientation film in two substrates 16 and 17, some polyurethane system resin whose magnitude is about 10 micrometers was put on one substrate, the spacer 45 was formed in one side, the sealant 101 was formed in another side, lamination and liquid crystal were poured in, and the panel was manufactured. Consequently, polyurethane system resin 700 extended area by heat and cel thickness (cel gap) formation, and the poor display by liquid crystal contamination was accepted in 15-micrometer angle in 0.5-2mm centering on breadth and polyurethane system resin 700.

[0258] The magnitude of polyurethane system resin 700 is changed and the result of having investigated the contamination area size of liquid crystal is shown in drawing 209. If it is beyond the display within 0.3mm angle on a panel and is satisfactory, it is necessary to use magnitude of polyurethane system resin below as 5-micrometer angle. This was the same also about the skin. As mentioned above, polyurethane system resin and the skin reduce the specific resistance of liquid crystal, and it generates a poor display owing to. The amount of mixing of polyurethane system resin and the relation of a fall of specific resistance were investigated. Drawing 210 is drawing showing the frequency dependent count result of the equal circuit of the liquid crystal pixel which the gate shows in drawing 211 supposing the condition of ON. A graph shows change of the effective voltage to a frequency in case resistance is 9.1x109, 9.1x1010, 9.1x1011, and 9.1x1012ohms in the equal circuit of a liquid crystal pixel. It turns out that the fall of the resistance of liquid crystal will produce the fall of effective voltage from now on. In the 1-60Hz frequency range related to an actual display, it turns out that the

abnormalities of a display occur in the fall of the specific resistance of triple or more figures.
[0259] Drawing 211 and drawing 212 are drawings showing by the time amount of which the charge once accumulated supposing the condition that the liquid crystal pixel holds the charge when resistance was 9.1x1010, 9.1x1011, and 9.1x1012ohms is discharged. In addition, an example in case only the orientation film exists is shown as reference. Since the orientation film has strong resistance and the time constant is large, it hardly contributes to a discharge phenomenon. Drawing 212 expands and shows the part for 0.2 or less ms of drawing 211. From now on, when liquid crystal resistance is low double or more figures, it will turn out that a black stain begins to appear in 60Hz.
[0260] The above thing shows becoming a problem if resistance falls figures triple [2-] by polyurethane system resin or the skin. Next, after putting a phenylurethane into liquid crystal, the supersonic wave was applied for 10 seconds, it was left after that, and the specific resistance of a supernatant was measured. This result showed that the amount of mixing of polyurethane system resin carried out by the mole ratio, and specific resistance carried out a digit extent fall about by 1/1000.
[0261] The above thing showed that display unevenness was level which does not produce a problem, when making the amount of mixing of polyurethane system resin or the skin or less into 1/1000 by the mole ratio. In order to make the amount of mixing of polyurethane system resin or the skin below into the above level, it is necessary to make into the air cleanliness class corresponding to the above-mentioned level suspension level of the polyurethane system resin in the clean room which manufactures a liquid crystal panel, or the skin. Furthermore, the process which washes a substrate front face with pure water at the front like an assembler is established.
[0262] In the above, the example of the liquid crystal display panel of VA method which divides the orientation of liquid crystal with a domain regulation means was explained. As already explained, using a phase contrast film is known as an approach of raising a viewing-angle property. Next, the property of the phase contrast film suitable for the liquid crystal display panel of VA method which quadrisects the direction of orientation of liquid crystal at an equal rate within 1 pixel as shown in drawing 55, and the example of arrangement are explained.
[0263] Drawing 213 is drawing showing the basic configuration of the liquid crystal panel of VA method. As shown in drawing 213, by pinching liquid crystal among the electrodes 12 and 13 formed on two substrates, a liquid crystal panel is realized and two polarizing plates 11 and 15 with which an absorption shaft intersects perpendicularly mutually are arranged on both sides. The liquid crystal panel used here is a liquid crystal display panel of VA method which the perpendicular orientation film is formed, the liquid crystal which has a negative dielectric constant anisotropy is used, and the 180 degrees of the directions of rubbing of the upper substrate 12 and the bottom substrate 13 are changed like illustration, and made 45 degrees to the absorption shaft of polarizing plates 11 and 15. In this equipment, the viewing-angle field which produces tone reversal for contrast curves, such as a time of seeing a panel from all bearings to 80 degrees of slant, in drawing 214 at the time of 8 gradation drives is shown in drawing 215. The contrast in bearing (0 degree, 90 degrees, 180 degrees, and 270 degrees) is low, and these results show that tone reversal arises in the quite large viewing-angle range.
[0264] As shown in drawing 216, the viewing-angle field which produces tone reversal for a contrast curve -- it can set to the liquid crystal display which used the liquid crystal panel which consists of two liquid crystal substrates 91 and 92 with which the projection pattern as shown in drawing 55 was formed -- in drawing 217 at the time of 8 gradation drives is shown in drawing 218. It can be said that this is still insufficient compared with the conventional VA method although improved about tone reversal, and it has seldom improved about contrast.

[0265] These people are Japanese Patent Application No. No. 41926 [eight to], Japanese Patent Application No. No. 29455 [nine to] which sets it as the foundation of priority, and Japanese Patent Application No. No. 259872 [eight to], and are indicating that a viewing-angle property makes it improve by preparing a phase contrast film in the liquid crystal display of VA method in which orientation division is carried out by rubbing. However, about the case where orientation division is carried out to the slit of a projection, a hollow, and a pixel electrode, reference is not made at all.
[0266] The conditions in the case of improving further the viewing-angle property in the liquid crystal display of VA method which was made to carry out orientation division within each pixel by the slit prepared in the projection, the hollow, and the electrode hereafter by preparing a phase contrast film are explained. First, the phase contrast film used in this invention is explained with reference to drawing 219. it is shown in drawing 219

-- as -- the refractive index of film plane inboard -- nx -- the refractive index of ny and the thickness direction -- nz ** -- when it carries out, with the phase contrast film used in this invention, the relation of nx and ny >=nz (however, nx =ny =nz removes) is realized.
[0267] Here, it is nx >ny =nz. It is called the phase contrast film which has optically uniaxial [forward] for the phase contrast film with which relation is realized optically in a film plane on these specifications, and this film is only henceforth called a forward optically uniaxial film. A refractive index nx and ny The direction of the larger one is called a lagging axis inside. in this case, nx >ny it is -- since -- x directions are called a lagging axis. If thickness of a phase contrast film is set to d, the retardation of Rs=(nx-ny) d will be produced in field inboard by passing this forward optically uniaxial film. Henceforth, when it is called the retardation of a forward optically uniaxial film, the retardation of field inboard (transverse plane) shall be pointed out.
[0268] Moreover, nx =ny >nz It is called the phase contrast film which has optically uniaxial [negative] for the phase contrast film with which relation is realized optically in the direction of a normal of a film plane on these specifications, and this film is only henceforth called a negative optically uniaxial film. If thickness of a phase contrast film is set to d, the retardation of Rd=(nx+ny) (/2-nz) d will be produced in the thickness direction by passing this negative optically uniaxial film. Henceforth, when it is called the retardation of a negative optically uniaxial film, the retardation of the thickness direction shall be pointed out.
[0269] Furthermore, nx >ny >nz It is called the phase contrast film which has biaxial nature for the phase contrast film with which relation is realized on these specifications, and this film is only henceforth called a biaxial nature film. in this case, nx >ny it is -- since -- x directions are called a lagging axis. When thickness of a phase contrast film is set to d, the retardation of d (nx-ny) (at however, the time of nx >ny) and the thickness direction of a film of the retardation of film plane inboard is d (/(nx+ny)2-nz).
[0270] Drawing 220 is drawing showing the configuration of the liquid crystal display of the 52nd example of this invention. A color filter and a common electrode (solid electrode) are formed in the side which faces the liquid crystal of one CF substrate of substrates 91 and 92, and the TFT component, the bus line, and the pixel electrode are formed in the side which faces the liquid crystal of the TFT substrate of another side. A perpendicular orientation ingredient is applied by decalcomania and the perpendicular orientation film is formed in the side which faces the liquid crystal of substrates 91 and 92 by calcinating by 180-degreeC. On the perpendicular orientation film, the protective material made from positive type sensitization is applied with a spin coat, and the projection pattern shown in drawing 55 is formed of Puri **-KU, exposure, and postbake.
[0271] Substrates 91 and 92 enclose the liquid crystal ingredient which is stuck through a spacer with a diameter of 3.5 micrometers and has a negative dielectric constant isomerism, and are using it as the liquid crystal panel. As shown in drawing 220, two substrates 91 and 92 with which the liquid crystal display of the 52nd example constitutes the 1st polarizing plate 11, the 1st forward optically uniaxial film 94, and a liquid crystal panel, the 2nd forward optically uniaxial film 94, and the 2nd polarizing plate 15 are arranged at this sequence. In addition, the absorption shaft of the 1st polarizing plate 11 and the lagging axis of the 1st forward optically uniaxial film 94 cross at right angles, and the lagging axis of the 2nd forward optically uniaxial film 94 is arranged so that it may intersect perpendicularly with the absorption shaft of the 2nd polarizing plate 15.
[0272] the 52nd example -- setting -- retardation R0 of the 1st and 2nd forward optically uniaxial films 94 R1 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 110nm, respectively in drawing 221 at the time of 8 gradation drives is shown in drawing 222. As compared with Fig. 217 and 218, the range where high contrast is acquired stops having produced breadth and tone reversal in all the range sharply, and the viewing-angle property has been sharply improved so that clearly.
[0273] here -- the configuration of drawing 220 -- retardation R0 of the 1st and 2nd forward optically uniaxial films 94 R1 It was made to change variously and the viewing-angle property was investigated. The approach of investigating is R0. R1 Make it change and it sets at the upper right (45-degree bearing) of a panel, the upper left (135-degree bearing), the lower left (225-degree bearing), and the lower right (315 degrees). It asks for the include angle from which contrast is set to 10, and is R0. R1 R0 from which the include angle becomes the same value on a coordinate R1 A high line chart, such as having connected the point with the line, is shown in drawing 223. In addition, the contour-line graph of the upper right of a panel, the upper left, the lower left, and the lower right was the same. Since this used the projection pattern shown in drawing 55, it is considered to be because for four fields depended comparatively to be equal by orientation.
[0274] R0 from which the include angle from which contrast becomes 10 in the bearing (45 degrees, 135 degrees, 225 degrees, and 315 degrees) is 39 degrees in drawing 217, and the include angle from which contrast

is set to 10 becomes 39 degrees or more in drawing 223 R1 In combination, it can be said that it is about the effectiveness which used the phase contrast film. in drawing 223, the include angle from which contrast is set to 10 becomes 39 degrees or more -- R0 R1 It is a time of the following conditions being fulfilled.

[0275] R1 <=450 nm-R0, R0-250 nm<=R1 <=R0+250nm, and 0 <=R0 And 0 <=R1

Moreover, retardation deltan-d of a liquid crystal cell is changed in the practical range, a twist angle is further changed in 0 degree - 90 degrees, and it is R0 similarly. R1 As a result of searching for optimum conditions, it was checked that it is not different from the above-mentioned conditions.

[0276] Drawing 224 is drawing showing the configuration of the liquid crystal display of the 53rd example of this invention. As for differing from the 52nd example, the forward optically uniaxial film, the 1st and the 2nd, 94 of two sheets is arranged between the 1st polarizing plate 11 and liquid crystal panel, and the forward optically uniaxial film 94 of two sheets is the point that the lagging axis is arranged so that the absorption shaft of the 1st polarizing plate 11 and the lagging axis of the 2nd forward optically uniaxial film which intersects perpendicularly mutually and adjoins the 1st polarizing plate 11 may cross at right angles.

[0277] the 53rd example -- setting -- phase contrast R0 and R1 of the 1st and 2nd forward optically uniaxial films 94 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 110nm and 270nm, respectively in drawing 225 at the time of 8 gradation drives is shown in drawing 226. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.

[0278] the 52nd example -- the same -- the configuration of drawing 224 -- retardation R0 of the 1st and 2nd forward optically uniaxial films 94 R1 The result of having changed variously and having investigated the viewing-angle property is shown in drawing 227. the include angle from which the property shown in drawing 227 is the same as drawing 223, and contrast is set to 10 -- R0 R1 a coordinate top -- it is -- etc. -- it considers as a high line chart. It is R0 that the include angle from which contrast is set to 10 will become 39 degrees or more from now on. R1 It is a time of the following conditions being fulfilled.

[0279]

1<=2R0+280nm of 2R0-170 nm<=R,

R1 <=-R0 / 2+800nm, and 0 <=R0 And 0 <=R1

Moreover, even if it changes retardation deltan-d of a liquid crystal cell in the practical range and changed the twist angle in 0 degree - 90 degrees further also in the 53rd example, it checked that it was not different from the above-mentioned conditions.

[0280] Drawing 228 is drawing showing the configuration of the liquid crystal display of the 54th example of this invention. Differing from the 52nd example is the point that arrange the 1st negative optically uniaxial film 95 between a liquid crystal panel and the 1st polarizing plate 11, and it arranges the 2nd negative optically uniaxial film 95 between a liquid crystal panel and the 2nd polarizing plate 15.

[0281] the 54th example -- setting -- the 52nd example -- the same -- the configuration of drawing 228 -- retardation R0 of the thickness direction of the 1st and 2nd negative optically uniaxial films 95 R1 The result of having changed variously and having investigated the viewing-angle property is shown in drawing 229. the include angle from which the property shown in drawing 229 is the same as drawing 223, and contrast is set to 10 -- R0 R1 a coordinate top -- it is -- etc. -- it considers as a high line chart. It is R0 that the include angle from which contrast is set to 10 will become 39 degrees or more from now on. R1 It is a time of the following conditions being fulfilled.

[0282] R0+R1 <=500nm

Here, also in the 54th example, retardation deltan-d of a liquid crystal cell was changed in the practical range, and the relation between deltan-d and the upper limit of optimum conditions was investigated. The result is shown in drawing 230. When deltan-d of a liquid crystal cell is set to RLC from this, the optimum conditions of the sum of the retardation of a Gentlemen phase reference film are less than [1.7xRLC+50nm].

[0283] Moreover, although this condition was a property about contrast, optimum conditions were similarly examined about tone reversal. the case of contrast -- the same -- the configuration of drawing 228 -- it is -- retardation R0 of the thickness direction of the 1st and 2nd negative optically uniaxial films 95 R1 the include angle which is changed variously and produces tone reversal -- asking -- R0 R1 a coordinate top -- it is -- etc. -- it is drawing 231 which was considered as the high line chart. The include angle which produces tone reversal in drawing 218 is 52 degrees. R0 from which the include angle which tone reversal produces in drawing 231

becomes 52 degrees or more R1 On conditions, it can be said that it is about the effectiveness of a phase contrast film about tone reversal. in drawing 231, the include angle which tone reversal produces becomes 52 degrees or more -- R0 R1 ******** -- it is a time of the following conditions being fulfilled.

[0284] R0+R1 <=345nm

Next, retardation deltan-d of a liquid crystal cell was changed in the practical range, and the relation between deltan-d and the upper limit of optimum conditions was investigated. The result is shown in drawing 232. Almost more fixed [the upper limit of optimum conditions / without being based on deltan-d of a liquid crystal cell] than this, the optimum conditions of the sum of the retardation of a Gentlemen phase reference film are 350nm or less.

[0285] As for the include angle from which contrast is set to 10, it is desirable that it is 50 degrees or more, and when it takes into consideration also about deltan-d of tone reversal or a practical liquid crystal cell, as for the sum of the retardation of a Gentlemen phase reference film, it is desirable that it is [30nm or more] 270nm or less. Moreover, as a result of changing a twist angle in 0 to 90 degrees and investigating it similarly, it turned out that there is no change in optimum conditions.

[0286] The 55th example removes one side of the 1st and 2nd negative optically uniaxial films 95 in the configuration of the liquid crystal display of the 54th example of drawing 228. In the 55th example, the viewing-angle field where tone reversal produces the ** contrast curve at the time of setting the retardation of the negative optically uniaxial film 95 of one sheet to 200nm in drawing 233 at the time of 8 gradation drives is shown in drawing 234. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly. Moreover, although the optimum conditions from which contrast is set to 10, and the optimum conditions about tone reversal were examined, it turned out that what is necessary is just to use negative 1 axial film of one sheet which has a retardation equivalent to the sum of the retardation of negative 1 axial film of the 54th example.

[0287] It was the example which uses the 58th example combining forward 1 axial film and negative 1 axial film from the 56th example, and although there were various kinds of modifications about the approach of arrangement, it turned out that the configuration shown in the 58th example from the 56th example is effective. Drawing 235 is drawing showing the configuration of the liquid crystal display of the 56th example of this invention. Differing from the 52nd example is a point which uses the negative 1 axial film 95 instead of the 1st forward 1 axial film 94 arranged between a liquid crystal panel and the 1st polarizing plate 11.

[0288] It sets in the 56th example and is the retardation R0 of the film plane inboard of the forward optically uniaxial film 94. Retardation R1 of the thickness direction of 150nm and the negative optically uniaxial film 95 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 150nm in drawing 236 at the time of 8 gradation drives is shown in drawing 237. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.

[0289] The 56th example also examined optimum conditions about contrast. The optimum conditions about contrast are shown in drawing 238. The contents shown in drawing 238 are the same as drawing 223. Drawing 239 is drawing showing the configuration of the liquid crystal display of the 57th example of this invention. differing from the 52nd example is a point which has arranged the forward 1 axial film 94 between a liquid crystal panel and the 1st polarizing plate 11, and has arranged the 1 axial film 95 negative to it being alike between this forward 1 axial film 94 and the 1st polarizing plate 11. The lagging axis of the forward optically uniaxial film 94 is arranged so that it may intersect perpendicularly with the absorption shaft of the 1st polarizing plate 11.

[0290] It sets in the 57th example and is the retardation R0 of the film plane inboard of the forward optically uniaxial film 94. Retardation R1 of the thickness direction of 50nm and the negative optically uniaxial film 95 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 200nm in drawing 240 at the time of 8 gradation drives is shown in drawing 241. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.

[0291] The 57th example also examined optimum conditions about contrast. The optimum conditions about contrast are shown in drawing 242. The contents shown in drawing 242 are the same as drawing 223. Drawing 243 is drawing showing the configuration of the liquid crystal display of the 58th example of this invention.

differing from the 52nd example is a point which has arranged the negative 1 axial film 95 between a liquid crystal panel and the 1st polarizing plate 11, and has arranged the 1 axial film 94 forward to it being alike between this negative 1 axial film 95 and the 1st polarizing plate 11. The lagging axis of the forward optically uniaxial film 94 is arranged so that it may intersect perpendicularly with the absorption shaft of the 1st polarizing plate 11.

[0292] It sets in the 58th example and is the retardation R1 of the film plane inboard of the forward optically uniaxial film 94. Retardation R0 of the thickness direction of 150nm and the negative optically uniaxial film 95 The viewing-angle field where tone reversal produces the ** contrast curve at the time of being referred to as 150nm in drawing 244 at the time of 8 gradation drives is shown in drawing 245. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.

[0293] The 58th example also examined optimum conditions about contrast. The optimum conditions about contrast are shown in drawing 246. The contents shown in drawing 246 are the same as drawing 223. Drawing 247 is drawing showing the configuration of the liquid crystal display of the 59th example of this invention. Differing from the 52nd example is nz about the refractive index of nx, ny, and the thickness direction in the refractive index of field inboard between a liquid crystal panel and the 1st polarizing plate 11. When it carries out, it is the point that arrange the phase contrast film 96 which has the relation of nx and ny >=nz, and the forward 1 axial film 94 between a liquid crystal panel and the 2nd polarizing plate 15 is removed. The x axis of the phase contrast film 96 is arranged so that it may intersect perpendicularly with the absorption shaft of the 1st polarizing plate 11.

[0294] It sets in the 59th example and is a lagging axis, i.e., nx >ny, about the x axis of the phase contrast film 96. The viewing-angle field where tone reversal produces the ** contrast curve at the time of carrying out and setting the retardation RYZ of 55nm and the thickness direction to 190nm for the retardation Rxz of film plane inboard in drawing 248 at the time of 8 gradation drives is shown in drawing 249. As compared with Fig. 217 and 218, the range which breadth and tone reversal produce sharply was also sharply reduced for the range where high contrast is acquired, and the viewing-angle property has been sharply improved so that clearly.

[0295] Here, it is defined as RXZ=(nx-nz) d and RYZ=(ny-nz) d. Also in the 59th example, RXZ and RYZ were variously changed about contrast and optimum conditions were examined. The optimum conditions about contrast are shown in drawing 250. the contents shown in drawing 250 -- R0 R1 It is the same except corresponding to RXZ and RYZ, respectively. It is a time of the following conditions being fulfilled about RXZ and RYZ that the include angle from which contrast is set to 10 becomes 39 degrees or more from these results.

[0296] RXZ-250 nm<=RYZ<=RXZ+150nm, RYZ<=-RXZ+1000nm, 0 <=RYZ, 0 <=RXZ

It is the retardation of R0 and the thickness direction about the retardation of the field inboard of the phase contrast film 96 R1 If it carries out,

R0 =(nx-ny) d=RXZ-RYZ -- (at the time of nx >=ny)

R0 =(ny-nx) d=RYZ-RXZ -- (at the time of ny >=nx)

R1 =((nx +ny)/2-nz)d=(RXZ+RYZ)/2

Since ****** is realized, the optimum conditions about RXZ and RYZ are rewritten as follows.

[0297] R0 <=250nm, R1 <=500nm

That is, it is desirable for the retardation of field inboard to arrange so that it may intersect perpendicularly with the absorption shaft of the polarizing plate with which the lagging axis of a biaxial nature phase contrast film adjoins [the retardation of 250nm or less and the thickness direction] by 500nm or less. As a result of changing retardation deltan-d of a liquid crystal cell in the practical range and investigating the relation between deltan-d and the upper limit of optimum conditions, it turned out that it is always 250nm or less, without basing the optimum conditions of the retardation of field inboard on deltan-d of a liquid crystal cell. On the other hand, it depends for the optimum conditions of the phase contrast of the thickness direction on deltan-d of a liquid crystal cell. The result of having investigated the relation between deltan-d of a liquid crystal cell and the upper limit of the optimal range of the retardation of the thickness direction is shown in drawing 251. When the optimum conditions of the retardation of the thickness direction set deltan-d of a liquid crystal cell to RLC from this, it is less than [1.7xRLC+50nm].

[0298] In addition, optimum conditions were similarly investigated with the configuration of drawing 247 about the configuration which has arranged two or more phase contrast films 96 at least to one side between one liquid crystal panel side, the 1st polarizing plate 11 of both sides, or the 2nd polarizing plate 15. Consequently,

it turned out that the case where the retardation of the field inboard of the Gentlemen phase reference film 96 is 250nm or less, respectively, and the sum of the retardation of the thickness direction of the Gentlemen phase reference film 96 is less than [1.7xRLC+50nm] is optimum conditions.

[0299] Moreover, although the twist angle was changed in 0 degree - 90 degrees and optimum conditions were investigated similarly, each optimum conditions did not change. As a film 96, a forward optically uniaxial film (nx >ny =nz), a negative optically uniaxial film (nx =ny > nz), and an optically biaxial film (nx >ny > nz) can be considered, and independent or the case where it uses combining each is possible in the either.

[0300] As mentioned above, although the conditions of the optimal phase contrast film in the case of preparing a projection train in the side which faces the liquid crystal of two substrates which constitute a liquid crystal panel, and carrying out orientation division within a pixel were explained, also when carrying out orientation division to the slit of a hollow or a pixel electrode, a viewing-angle property can be improved on the same conditions. Moreover, the polarizing plate in this specification is described as an ideal polarizing plate. Therefore, the retardation (the phase contrast of the thickness direction is usually about 50nm) of what it should compound with the retardation which the phase contrast film of this invention has, and should be treated which the film (TAC film) which is used with the configuration of an actual polarizing plate, and which protects a polarizer has is obvious.

[0301] That is, although arrangement of a phase contrast film can be seemingly lost by making a TAC film possess the conditions in this invention, it cannot be overemphasized that a TAC film acts on the phase contrast film to which this invention should be added, and an EQC in this case. As mentioned above, although the example of this invention was explained, otherwise to this invention, various kinds of deformation is possible, and there may be various kinds of modifications according to the liquid crystal display which especially applies a projection pattern, a configuration, etc.

[0302] As mentioned above, although the example which applied this invention to the TFT mold liquid crystal display was explained, this invention is applicable also to liquid crystal displays other than this. For example, it can apply also to not TFT but LCD of an MOS-FET method used as a reflective mold, and the method which used diodes, such as an MIM component, as an active element, and can apply to what uses an amorphous silicon also by the TFT method, and both which use polish recon. Moreover, it is applicable not only to LCD of a transparency mold but LCD of a reflective mold or plasma addressing.

[0303]

[Effect of the Invention] Although the conventional TN mold LCD had the narrow viewing-angle range, the IPS mold LCD which improved the viewing-angle property did not have an enough speed of response and the trouble of being unable to use it was shown in the movie display, if this invention is applied, while solving these problems and having the viewing-angle property of the IPS mold LCD, LCD of a speed of response which endures the TN mold LCD is realizable. And since it is realizable only by establishing a projection or a hollow in each substrate, it is easily realizable also in respect of manufacture. And the required rubbing process and a washing-after rubbing process become unnecessary with conventional TN mold and a conventional IPS mold. Since these processes had become the cause which produces poor orientation, it is effective in raising the dependability of the yield or a product.

[0304] Furthermore, a viewing-angle property is sharply improvable by using a phase contrast film on conditions which were explained. It becomes high contrast with a large angle of visibility, and stops especially, also producing tone reversal on the optimal conditions.

[Brief Description of the Drawings]

[Drawing 1] It is drawing explaining the panel structure and the principle of operation of the TN mold LCD.

[Drawing 2] It is drawing explaining change of the image by the angle of visibility of the TN mold LCD.

[Drawing 3] It is drawing explaining the IPS mold LCD.

[Drawing 4] It is drawing showing the definition of the coordinate meter in the observation which made the IPS mold LCD the example.

[Drawing 5] It is drawing showing the tone reversal field in the IPS mold LCD.

[Drawing 6] It is drawing showing the change and tone reversal of gradation in the IPS mold LCD.

[Drawing 7] It is drawing explaining VA (Vertically aligned) method and its trouble.

[Drawing 8] It is the explanatory view of rubbing processing.

[Drawing 9] It is drawing explaining the principle of this invention.

[Drawing 10] It is drawing explaining generation of the orientation by projection.

[Drawing 11] It is drawing showing the example of a configuration of a projection.
[Drawing 12] It is drawing showing the method which realizes liquid crystal orientation of this invention.
[Drawing 13] It is drawing showing the whole liquid crystal panel configuration of the 1st example.
[Drawing 14] It is drawing showing the panel structure of the 1st example.
[Drawing 15] It is drawing showing the projection pattern of the 1st example.
[Drawing 16] It is drawing showing the projection pattern of the periphery in the 1st example.
[Drawing 17] It is a panel sectional view in the 1st example.
[Drawing 18] It is drawing showing arrangement of the liquid crystal inlet of the panel of the 1st example.
[Drawing 19] It is drawing showing the actual measurement of the projection configuration of the 1st example.
[Drawing 20] It is drawing showing the speed of response in the 1st example.
[Drawing 21] It is drawing showing the speed of response in the 1st example.
[Drawing 22] It is drawing showing the viewing-angle property in the 1st example.
[Drawing 23] It is drawing showing the viewing-angle property in the 1st example.
[Drawing 24] It is drawing showing the viewing-angle property in the 1st example.
[Drawing 25] It is drawing showing the viewing-angle property at the time of using a phase contrast film in the 1st example.
[Drawing 26] It is drawing showing the viewing-angle property at the time of using a phase contrast film in the 1st example.
[Drawing 27] It is drawing explaining generating of the leakage light in a projection part.
[Drawing 28] It is drawing showing change of the permeability when changing the height of a projection in the 1st example.
[Drawing 29] It is drawing showing change of the contrast when changing the height of a projection in the 1st example.
[Drawing 30] It is drawing showing the relation between the height of a projection in the 1st example, and the permeability of confession voice.
[Drawing 31] It is drawing showing the relation between the height of a projection in the 1st example, and the permeability of a black condition.
[Drawing 32] It is drawing showing the height of a projection in the 1st example, and the relation of a contrast ratio.
[Drawing 33] It is drawing showing the projection pattern of the 2nd example.
[Drawing 34] It is drawing showing the projection pattern of the 3rd example.
[Drawing 35] It is drawing showing other examples of the projection pattern of the 3rd example.
[Drawing 36] It is drawing showing the orientation of the liquid crystal molecule on a projection.
[Drawing 37] It is drawing showing the projection configuration of the 4th example.
[Drawing 38] It is drawing showing the panel structure of the 5th example.
[Drawing 39] It is drawing showing the pixel electrode pattern of the 5th example.
[Drawing 40] It is drawing showing the example of the orientation distribution in a slit connection.
[Drawing 41] It is drawing showing a projection in the 5th example, and generating of the domain in the slit section.
[Drawing 42] It is drawing showing the configurations of a projection in the 6th example, and the slit of an electrode.
[Drawing 43] It is drawing showing a projection in the 6th example, and generating of the domain in the slit section.
[Drawing 44] It is drawing showing the top view of the picture element part in the liquid crystal display of the 6th example.
[Drawing 45] It is drawing showing the pixel electrode pattern of the 6th example.
[Drawing 46] It is the sectional view of the picture element part of the 6th example.
[Drawing 47] It is drawing showing the viewing-angle property in the 6th example.
[Drawing 48] It is drawing showing the viewing-angle property in the 6th example.
[Drawing 49] It is drawing showing the modification of the pixel electrode pattern of the 6th example.
[Drawing 50] It is drawing showing the pixel electrode pattern and structure of the 7th example of this invention.
[Drawing 51] It is drawing showing the top view of the picture element part in the liquid crystal display of the

8th example of this invention.
[Drawing 52] It is the sectional view of the picture element part of the 8th example.
[Drawing 53] It is drawing explaining the manufacture approach of the TFT substrate in the 8th example.
[Drawing 54] It is drawing explaining the manufacture approach of the TFT substrate in the 8th example.
[Drawing 55] It is drawing showing the projection pattern of the 9th example of this invention.
[Drawing 56] It is the top view of the picture element part of the 9th example.
[Drawing 57] It is drawing showing the modification of the projection pattern of the 9th example.
[Drawing 58] It is drawing showing the effect of the slanting electric field in an electrode edge.
[Drawing 59] It is drawing showing the problem in the case of using the projection which made zigzag crooked.

[Drawing 60] It is drawing showing the orientation of the electrode edge section in the case of using the projection which made zigzag crooked.
[Drawing 61] When using the projection which made zigzag crooked, it is drawing showing the part to which a speed of response falls.
[Drawing 62] When using the projection which made zigzag crooked, it is the cross section of ****** to which a speed of response falls.
[Drawing 63] It is drawing showing the basic configuration of the 10th example of this invention.
[Drawing 64] It is drawing showing the projection train pattern in the 10th example.
[Drawing 65] It is the detail drawing of the description part in the 10th example.
[Drawing 66] It is drawing explaining change of the direction of orientation by the exposure of ultraviolet rays.
[Drawing 67] It is drawing showing the modification of the 10th example.
[Drawing 68] It is drawing showing the relation between a desirable edge and a projection.
[Drawing 69] It is drawing showing the relation between a desirable edge and a hollow.
[Drawing 70] It is drawing showing desirable straight-line-like array of a projection.
[Drawing 71] It is drawing showing the projection pattern in the 11th example of this invention.
[Drawing 72] It is drawing showing the example which prepared the projection of discontinuity for every pixel.
[Drawing 73] It is drawing showing the projection pattern in the 12th example of this invention.
[Drawing 74] It is drawing showing the modification of the 12th example.
[Drawing 75] It is drawing showing the modification of the 12th example.
[Drawing 76] It is drawing showing the projection pattern in the 13th example of this invention.
[Drawing 77] It is the sectional view of the 3rd example.
[Drawing 78] It is drawing showing an operation and electrode structure of auxiliary capacity.
[Drawing 79] It is drawing showing the projection pattern and CS electrode of the 14th example of this invention.
[Drawing 80] It is drawing showing the modification of the 14th example.
[Drawing 81] It is drawing showing the modification of the 14th example.
[Drawing 82] It is drawing showing the modification of the 14th example.
[Drawing 83] It is drawing showing the projection pattern of the 15th example of this invention.
[Drawing 84] It is drawing explaining orientation change of the liquid crystal in the 15th example.
[Drawing 85] It is drawing showing the viewing-angle property in the 15th example.
[Drawing 86] It is drawing showing the halftone speed of response of TN method for the speed of response of the halftone in the 15th example, and a comparison.
[Drawing 87] It is drawing showing the speed of response of the halftone of other VA methods.
[Drawing 88] It is drawing showing the modification of the projection pattern of the 15th example.
[Drawing 89] It is drawing showing the modification of the projection pattern of the 15th example.
[Drawing 90] It is drawing showing the modification of the projection pattern of the 15th example.
[Drawing 91] It is drawing showing the modification of the projection pattern of the 15th example.
[Drawing 92] It is drawing showing the projection structure of the 16th example of this invention.
[Drawing 93] It is drawing showing the projection pattern of the 16th example.
[Drawing 94] It is drawing showing the panel structure of the 17th example of this invention.
[Drawing 95] It is drawing showing the panel structure of the 18th example of this invention.
[Drawing 96] It is drawing showing the panel structure of the 19th example of this invention.
[Drawing 97] It is drawing showing the panel structure of the 20th example of this invention.

[Drawing 98] It is drawing showing the panel structure of the modification of the 20th example.
[Drawing 99] It is drawing showing the panel structure of the modification of the 20th example.
[Drawing 100] It is drawing showing the panel structure of the modification of the 20th example.
[Drawing 101] It is drawing showing the panel structure of the 21st example of this invention.
[Drawing 102] It is drawing showing the effect on the orientation division by the panel sectional view and assembly which have a projection.
[Drawing 103] It is drawing showing the panel structure of the 22nd example of this invention.
[Drawing 104] It is drawing showing the panel structure of the 23rd example of this invention.
[Drawing 105] It is drawing showing the panel structure of the 24th example of this invention.
[Drawing 106] It is drawing showing the projection pattern adapting the structure of the 24th example.
[Drawing 107] It is drawing showing the panel structure of the 25th example of this invention.
[Drawing 108] It is drawing showing the structure of the panel which measures the relation between a projection gap and a speed of response.
[Drawing 109] It is drawing showing the relation between a projection gap and a speed of response.
[Drawing 110] It is drawing showing the relation between a projection gap and permeability.
[Drawing 111] It is the explanatory view of the principle of operation of the 25th example.
[Drawing 112] It is drawing showing the panel structure of the 26th example of this invention.
[Drawing 113] It is drawing showing the viewing-angle property of the panel of the 26th example.
[Drawing 114] It is drawing showing the usual projection pattern.
[Drawing 115] It is drawing showing the wavelength dispersion of the optical anisotropy of liquid crystal.
[Drawing 116] It is drawing showing the projection pattern of the 27th example of this invention.
[Drawing 117] It is drawing showing the difference by the projection gap of the relation between applied voltage and permeability.
[Drawing 118] It is drawing showing the projection pattern of the 28th example of this invention.
[Drawing 119] It is drawing showing the projection pattern of the 29th example of this invention.
[Drawing 120] It is drawing showing the pixel structure of the 29th example.
[Drawing 121] It is drawing showing the projection configuration of the 30th example of this invention.
[Drawing 122] It is drawing showing change of the permeability when changing the height of a projection.
[Drawing 123] It is drawing showing change of the contrast when changing the height of a projection.
[Drawing 124] It is drawing showing the relation between the height of a projection, and the permeability of confession voice.
[Drawing 125] It is drawing showing the relation between the height of a projection, and the permeability of a black condition.
[Drawing 126] It is drawing showing the modification of the 30th example.
[Drawing 127] It is drawing showing the projection configuration of the 31st example of this invention.
[Drawing 128] It is drawing showing the relation of the thickness of the twist angle of the liquid crystal panel of VA method, and a liquid crystal layer.
[Drawing 129] It is drawing showing the relative luminance of a white display of the liquid crystal panel of VA method, and the relation of retardation deltand of liquid crystal.
[Drawing 130] It is drawing showing the square-corrugated length transmission of the liquid crystal panel of VA method, and the relation of retardation deltand of liquid crystal.
[Drawing 131] It is drawing showing the gap of the liquid crystal panel of an orientation division VA method, and the relation of a speed of response.
[Drawing 132] It is drawing showing the gap of the liquid crystal panel of an orientation division VA method, and the relation of a numerical aperture.
[Drawing 133] It is drawing showing the panel structure of the 32nd example of this invention.
[Drawing 134] It is drawing showing the panel structure of the modification of the 32nd example.
[Drawing 135] It is drawing showing the structure of the TFT substrate of the 33rd example of this invention.
[Drawing 136] It is drawing showing the projection pattern of the 33rd example.
[Drawing 137] It is drawing showing the panel structure of the 34th example of this invention.
[Drawing 138] It is drawing showing the projection pattern of the 34th example.
[Drawing 139] It is drawing showing the manufacture approach of the TFT substrate of the 35th example of this invention.

[Drawing 140] It is drawing showing the structure of the TFT substrate of the modification of the 35th example.

[Drawing 141] It is drawing showing the manufacture approach of the TFT substrate of the 36th example of this invention.
[Drawing 142] It is drawing explaining the problem by the dielectric on an electrode.
[Drawing 143] It is drawing showing the projection structure of the 37th example of this invention.
[Drawing 144] It is drawing showing the manufacture approach of a projection of the 37th example.
[Drawing 145] It is drawing showing the projection structure of the 38th example of this invention.
[Drawing 146] It is drawing showing change of the projection configuration by baking.
[Drawing 147] It is drawing showing change of the cross-section configuration of the resist by burning temperature.
[Drawing 148] It is drawing showing the relation between line breadth and the cross-section configuration of a resist.
[Drawing 149] It is drawing showing the problem in the situation of a height, and spreading of the orientation film.
[Drawing 150] It is drawing showing an example of the projection manufacture approach of the 39th example of this invention, and the manufactured projection.
[Drawing 151] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 152] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 153] It is the graph which shows reforming by ultraviolet-rays exposure of a resist.
[Drawing 154] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 155] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 156] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 157] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 158] It is drawing showing the temperature-change conditions of the approach of drawing 157.
[Drawing 159] It is drawing showing other examples of the projection manufacture approach of the 39th example.
[Drawing 160] It is drawing showing the panel structure of the conventional example of having a black matrix.
[Drawing 161] It is drawing showing the panel structure of the 40th example of this invention.
[Drawing 162] It is drawing showing the projection pattern of the 40th example.
[Drawing 163] It is drawing showing the protection-from-light pattern (black matrix) of the 41st example of this invention.
[Drawing 164] It is the sectional view of the 41st example.
[Drawing 165] It is drawing showing the pixel and projection pattern of the 42nd example of this invention.
[Drawing 166] It is drawing showing the conventional panel structure where the spacer was formed.
[Drawing 167] It is drawing showing the panel structure of the 43rd example and modification of this invention.

[Drawing 168] It is drawing showing the panel structure of the modification of the 43rd example.
[Drawing 169] It is drawing showing the panel structure of the modification of the 43rd example.
[Drawing 170] It is drawing showing the manufacture approach of the liquid crystal panel of the 44th example of this invention.
[Drawing 171] It is drawing showing the spraying consistency of a spacer and the relation of a cel gap to the 44th example.
[Drawing 172] It is drawing showing the relation of generating of the unevenness when applying the spraying consistency and force of a spacer in the liquid crystal panel of the 44th example.
[Drawing 173] It is drawing showing the chemical formula of the charge of add-in material for giving the ion adsorption capacity force to a projection.

[Drawing 174] It is drawing showing the chemical formula of the charge of add-in material for giving the ion adsorption capacity force to a projection.
[Drawing 175] It is drawing showing the structure of CF substrate of the 45th example of this invention.
[Drawing 176] It is drawing showing the panel structure of the 46th example of this invention.
[Drawing 177] It is drawing showing the structure of CF substrate of the modification of the 46th example.
[Drawing 178] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 179] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 180] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 181] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 182] It is drawing showing other examples of structure of CF substrate of the modification of the 46th example.
[Drawing 183] It is drawing showing a projection and the BM formation approach of CF substrate of the 47th example of this invention.
[Drawing 184] It is drawing showing a projection and the BM formation approach of CF substrate of the 47th example.
[Drawing 185] It is drawing showing the panel structure of the 47th example.
[Drawing 186] It is drawing showing the BM manufacture approach of CF substrate of the 48th example of this invention.
[Drawing 187] It is drawing showing the panel structure of the 48th example.
[Drawing 188] It is drawing showing the manufacture approach of CF substrate of the 49th example of this invention.
[Drawing 189] It is drawing showing the panel structure of the 49th example.
[Drawing 190] It is drawing showing the manufacture approach of CF substrate of the 50th example of this invention.
[Drawing 191] It is drawing showing the panel structure of the 50th example.
[Drawing 192] It is drawing showing the structure of CF substrate of the 51st example of this invention.
[Drawing 193] It is drawing showing the modification of the 51st example.
[Drawing 194] It is drawing showing the modification of the 51st example.
[Drawing 195] It is drawing showing the modification of the 51st example.
[Drawing 196] It is drawing showing the modification of the 51st example.
[Drawing 197] It is drawing showing the display adapting the liquid crystal panel of this invention.
[Drawing 198] It is drawing showing the configuration of the display in the application of the liquid crystal panel of this invention.
[Drawing 199] It is drawing showing rotation of the projection pattern in the application of the liquid crystal panel of this invention.
[Drawing 200] It is the flow chart which shows the production process of the liquid crystal panel of this invention.
[Drawing 201] It is the flow chart which shows the projection formation process of the liquid crystal panel of this invention.
[Drawing 202] It is drawing showing the configuration of the equipment for forming a projection by printing.
[Drawing 203] It is drawing showing the configuration of a liquid crystal injector.
[Drawing 204] It is drawing showing the example of arrangement of the inlet to a projection with the liquid crystal panel of this invention.
[Drawing 205] It is drawing showing the example of arrangement of the inlet to a projection with the liquid crystal panel of this invention.
[Drawing 206] It is drawing showing the example of arrangement of the inlet to a projection with the liquid crystal panel of this invention.
[Drawing 207] It is drawing showing the electrode structure near the inlet in the liquid crystal panel of this invention.

[Drawing 208] It is drawing showing generating of the abnormalities in a display when polyurethane system resin mixes with the liquid crystal panel of this invention.
[Drawing 209] It is drawing showing the relation between the magnitude of polyurethane system resin, and liquid crystal contamination area size.
[Drawing 210] It is drawing showing the simulation result which shows the fall of effective voltage to the frequency by the difference of specific resistance.
[Drawing 211] It is drawing showing the simulation result of the charging time value of the charge by the difference of specific resistance.
[Drawing 212] It is drawing showing the simulation result of the charging time value of the charge by the difference of specific resistance.
[Drawing 213] It is drawing showing the configuration of the liquid crystal display of VA method.
[Drawing 214] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of VA method.
[Drawing 215] It is drawing showing the viewing-angle field which tone reversal produces in the liquid crystal display of VA method.
[Drawing 216] It is drawing showing the configuration of the display which used new VA method panel which has a domain regulation means.
[Drawing 217] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of new VA method.
[Drawing 218] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of new VA method.
[Drawing 219] It is drawing explaining the property of a phase contrast film.
[Drawing 220] It is drawing showing the configuration of the liquid crystal display of the 52nd example of this invention.
[Drawing 221] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 52nd example.
[Drawing 222] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 52nd example.
[Drawing 223] It is drawing showing the change to the amount of phase contrast of the include angle from which the contrast seen from the slant in the liquid crystal display of the 52nd example becomes a predetermined value.
[Drawing 224] It is drawing showing the configuration of the liquid crystal display of the 53rd example of this invention.
[Drawing 225] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 53rd example.
[Drawing 226] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 53rd example.
[Drawing 227] It is drawing showing the change to the amount of phase contrast of the include angle from which the contrast seen from the slant in the liquid crystal display of the 53rd example becomes a predetermined value.
[Drawing 228] It is drawing showing the configuration of the liquid crystal display of the 54th example of this invention.
[Drawing 229] It is drawing showing the change to the amount of phase contrast of the include angle from which the contrast seen from the slant in the liquid crystal display of the 54th example becomes a predetermined value.
[Drawing 230] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 54th example.
[Drawing 231] It is drawing showing the change to the amount of phase contrast of the marginal angle which does not produce tone reversal in the liquid crystal display of the 54th example.
[Drawing 232] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the tone reversal in the liquid crystal display of the 54th example.
[Drawing 233] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 55th example of this invention.

[Drawing 234] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 55th example.
[Drawing 235] It is drawing showing the configuration of the liquid crystal display of the 56th example of this invention.
[Drawing 236] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 56th example.
[Drawing 237] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 56th example.
[Drawing 238] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 56th example.
[Drawing 239] It is drawing showing the configuration of the liquid crystal display of the 57th example of this invention.
[Drawing 240] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 57th example.
[Drawing 241] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 57th example.
[Drawing 242] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 57th example.
[Drawing 243] It is drawing showing the configuration of the liquid crystal display of the 58th example of this invention.
[Drawing 244] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 58th example.
[Drawing 245] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 58th example.
[Drawing 246] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 58th example.
[Drawing 247] It is drawing showing the configuration of the liquid crystal display of the 59th example of this invention.
[Drawing 248] It is drawing showing the viewing-angle property of the contrast in the liquid crystal display of the 59th example.
[Drawing 249] It is drawing showing the viewing-angle property of the tone reversal in the liquid crystal display of the 59th example.
[Drawing 250] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 59th example.
[Drawing 251] It is drawing showing the change to the amount of retardations of the liquid crystal of the optimum conditions about the contrast in the liquid crystal display of the 59th example.
[Drawing 252] It is drawing showing the measurement result of the property of the liquid crystal panel of the 32nd example of this invention.
[Drawing 253] It is drawing showing change of the ion density when performing processing which gives the ion adsorption capacity force to a projection.
[Drawing 254] It is drawing showing the manufacture approach of the liquid crystal panel of the modification of the 51st example of this invention.
[Drawing 255] It is drawing showing the projection pattern and cross-section structure of a modification of the 2nd example.
[Drawing 256] It is drawing showing the projection pattern of the modification of the 2nd example.
[Drawing 257] It is drawing showing the projection pattern and cross-section structure of a modification of the 16th example.
[Drawing 258] It is drawing showing arrangement of the auxiliary projection in the modification of the 10th example.
[Description of Notations]
9 -- Pixel
11 15 -- Polarizing plate
12 -- CF lateral electrode

13 -- Pixel electrode
14 -- Liquid crystal molecule
16 17 -- Glass substrate
18 19 -- Electrode
20, 20A, 20B -- Domain regulation means (projection)
21 -- Domain regulation means (slit)
22 -- Perpendicular orientation film
23 -- Domain regulation means (hollow)
31 -- Gate bus
32 -- Address bus
33 -- TFT
34 -- Light-shielding film
35 -- CS electrode
41 -- Source
42 -- Drain
45 -- Spacer
[Procedure amendment 2]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] drawing 17
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 17]
[Procedure amendment 3]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] drawing 90
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 90]
[Procedure amendment 4]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] Drawing 161
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 161]
[Procedure amendment 5]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] Drawing 162
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 162]
[Procedure amendment 6]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] Drawing 167
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 167]
[Procedure amendment 7]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] Drawing 170
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 170]

[Translation done.]